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MOTOR LOADS IN HOTELS.

To the central station which numbers one or more modern hotels among its customers the chance for the development of power business is worth following closely, for there is no field where the advantages of the electric motor are more conspicuous. The great problem in operating a hotel is to keep the labor cost down, since in many houses there are often from one to one and a half employés per guest. The wages of many hotel attendants are small, but rarely anywhere near enough to be more economical than a machine capable of doing the same work. The organization of the larger city hotels has been carried to a point of great refinement, but it is a question if the size of the staff can not be very materially reduced by the installation of motor-driven machinery to a wider extent than has generally been the case in the past.

Upon the cleanliness and speed of the service the patronage of a first-class hotel largely depends. Labor-saving devices are therefore at a premium in the management of the most progressive hostelries. In the kitchen and laundry the electric motor affords the cleanest of all powers. It economizes floor space, enables the best lighting conditions to be enjoyed in the culinary department, allows the location of any machine at the most convenient point, and thus facilitates the quickest handling of both raw materials and cooked-food products. It is a great convenience to be able to put a motor-operated machine well out of the reach of the ranges, ovens, broilers, cold-storage chests and other equipment frequently visited by employés, and here the motor drive contributes directly to the acceleration of the service to and from the dining rooms. The severity of the surrounding conditions causes little embarrassment in a motor installation, and the time spent in repairs by the generally overworked maintenance staff of a modern hotel is seldom chargeable in any considerable proportion to the electric motor.

The number of individual applications of motors that can be made to advantage in a large hotel with resources enough to purchase the most efficient labor-saving equipment is too great to specify in a simple list, but in almost every department the convenience of the motor drive justifies its adoption. Passenger and freight elevators, semiautomatic hoists and dumbwaiters, dish conveyers, ash hoists and coal lifts form a class of equipment by itself especially adapted to motor driving. A strong point in favor of the electric elevator is the fact that it takes power only in proportion to the load, while the hydraulic machine consumes practically full power regardless of the weight in the car. The choice between electric and hydraulic elevators is, however, a problem in itself, but for the smaller hoists there

is no other power as advantageous as electricity, both in respect of the speed of service and economy of operation. The electrically driven dumbwaiter has reached an advanced stage of development in the later hotel work, especially in its automatic features.

In the electrical operation of bread-mixing machinery, apple parers, bread-moulding machines, ice-cream freezers, fruit cleaners, pie trimmers, coffee grinders, meat and food choppers. silver polishers, knife grinders, cutlery brighteners, pitcher and silver buffers and scrapers, ice crushers, dish-washing machines and other smaller apparatus, there is an excellent chance to save labor through the use of the electric motor. Over steam the efficiency is undisputed, but the chief gain to the hotel management is, as indicated above, in the cost of attendance. When a single chopper driven by an one-horse-power motor will handle from 500 to 750 pounds of meat in an hour; when a two-horse-power washer will clean 3,000 dishes in sixty minutes, and a knife polisher brighten 250 knives in half an hour, the possible savings in hand labor become attractive. The cost of the machine is a small matter when its capital charges and operating expenses are balanced against the wages item with and without the machine under the conditions usually prevailing in hotel service. In the field of general motor application, driving small fans, pumps, refrigerating apparatus, and notably in keeping the odors of the kitchen away from the cafés, corridors, etc., in assisting fireplace ventilation, or in extracting smoky air from the banquet rooms, in operating sewing machines in the linen division, and in numerous other uses, the electric drive can be made so serviceable that the central station man who fails to emphasize these features in seeking to enlarge his power load in the hotel field lets slip an excellent opportunity to secure business of the most desirable kind.

THE RELATIVE HYGIENIC VALUES OF ELECTRIC INCANDESCENT LAMPS AND GAS.

Among the advantages claimed by the electric lighting companies for the incandescent lamp as compared with gas are its higher luminous efficiency and the fact that it does not give off useless, if not objectionable, gases. It is contended, and apparently with good reason, that since the incandescent lamp gives off only about half as much heat as an equivalent incandescent gas lamp, the latter will heat the air in a room to a higher temperature, which is a disadvantage when it is desired to keep the room cool, and since the gas lamp depends upon the combustion of gas for producing incandescence, and this combustion uses up oxygen, while there is no combustion in the incandescent lamp and no utilization of oxygen, the latter source of light should leave the air of a room in better condition for use by those persons therein. Theoretically, no fault can be found in these arguments, so that it only remains to demonstrate how far they apply to actual conditions. If living rooms were airtight there would be no doubt of what actual tests would show; but fortunately for the health of the race all buildings are more or less pervious to air, so that a certain amount of ventilation takes place without any special provision having been made for it. The air in a room is constantly changing at a rate depending upon many factors—the number of windows and doors, the character of the walls and ceiling, the state of the weather, and the location of the room with respect to other parts of the building, or to other buildings. In buildings of light structure the ventilation will generally take care of itself unless there be an unusual number of persons in a room at a time. But in the heavier buildings, such as are constructed of steel and brick, or stone, and which are usually heated by steam or hot water, ventilation must be provided. It, therefore, becomes an interesting question as to the effect of the source of light upon the air of a room and the additional ventilation necessitated by it.

Until about a year ago no figures obtained from actual tests had been published. Last summer, however, Mr. Vivian B. Lewes, in a lecture before the Royal Naval College, of Greenwich, England, touched upon this point and made the statement that the very features of the gas lamp which the electrician considered as faults were benefits, since the greater amount of heat set free, as compared with the incandescent electric lamp, and the volume of hot gases produced acted as ventilating agents and kept the air of the room purer and in a better condition for the use of the occupants. Mr. Lewes's contention, however, was spoiled by the manner of presentation, which was too obviously that of one determined at all hazards to show that gas was in every respect superior to electricity. Hence little weight was given to his statements and in the instances in which the electrical journals noticed them they were ridiculed.

More recently the question has been investigated somewhat carefully by Dr. Samuel Rideal, a recognized authority in sanitary matters in England. His results were presented to the Royal Sanitary Institute, and are given in abstract in the *Engineering News* for July 30. The investigation was carried out on three lines: into the direct effect of the light; into the effect of the products of combustion, respiration, perspiration, etc., and into the nature, amount and distribution of these products. A lack of information on the ventilation of rooms and the results of physiological examinations of persons while at their normal tasks made the investigation more troublesome than had been anticipated. About fifteen persons took part in the experiments, all normal individuals.

The experiments were carried out in a basement room of a London office building. This room had been formed by throwing two rooms, each fourteen feet by sixteen feet, into one. It had one front wall containing four windows. Later this room was cut into two similar rooms, each with two windows, by means of a wooden partition and screens. To minimize disturbances due to persons entering the rooms, air locks were constructed out of baize doors placed in the corridors at the entrance of each room. The rooms were cleaned and whitened before beginning the tests, and the ventilation was brought partially under control by means of an adjustable grating. From the results of the tests, however, there seems to have been ample

ventilation due to leakage around doors, windows, etc. At first the rooms were unheated, but when the weather turned cooler electric heaters were put in, this type being selected to avoid, as far as possible, bringing in any other agent which would affect the air in the rooms.

Before dividing the large room into two the gas and the electric lamps were used on alternate evenings. Afterward gas was used in one room while the electric lamps were used in the other, the two systems being used alternately so as to avoid any change which might result from the continuous use of one system in one room. Each room was fitted with a central fixture containing two electric and two gas lamps. Both types of lamp were rated at twenty-five candle-power, the gas lamps being of the inverted-mantle type taking 1.28 cubic feet of gas an hour, and the electric lamps consuming ninety-four watts each. The arrangements of the two types gave a more intense illumination on the table beneath the lamps, where the experimenters worked, when the gas lamps were in use, but a better general illumination when the electric lamps were employed. To these differences were attributed the slight difference in the optical effects noticed during the experiments. The heat liberated in an hour by the gas lamps was computed, from the calorific value of the gas, to be 1,382 British thermal units; that liberated by the electric lamps was something less than half this, being 658 British thermal units.

At first the ventilation was watched by determining the quality of the air before and after each evening's work, but the changes found were so slight and so variable that no satisfactory conclusions could be drawn. Then the plan of introducing a large quantity of carbon dioxide was resorted to. This was thoroughly mixed with the air of the rooms, and the rate at which the air returned to normal was taken as a measure of the ventilation. This method showed apparently that there was a slightly better ventilation when the lighting was done by gas than by electricity, a result attributed to the greater amount of heat produced and the hot products of combustion. But it was found that the heat given off by the occupants of the room and their movements had much more to do with the ventilation than either of the systems of illumination. Nor did changes in outside conditions, except the temperature, seem to have any effect; if anything the ventilation was somewhat better with a moderate wind blowing, or when the weather was fairly quiet, than when a strong wind prevailed. The only influence noticed was the difference in temperature between the air in the room and that outside; the greater this difference the more rapidly was the air of the room changed. This result is rather remarkable because the tests were carried out in a building with massive walls and the ventilation was restricted, and, moreover, it was computed that about twenty-eight per cent of all the heat developed in the room was carried away by the air, the remaining seventy-two per cent being carried off by radiation and conduction through the walls.

Other tests were made to study the effects of other influences: the humidity of the air was varied from very dry to very moist without appreciable effect on the occupants; the organic matter exhaled by those in the room was collected in potassium permanganate and it was found that less was collected in this way when gas was used for lighting, the burning gas evidently destroying a certain amount of these volatile substances; the traces of sulphur dioxide formed by the burning coal gas seemed to have a germicidal action on the bacteria existing in the room; coal gas was allowed to escape into one room at the rate of 8.8 cubic feet an hour for over four hours, but no serious symptoms were noticed in any of the three men who remained in it.

The *Engineering News*, in an editorial commenting upon this work, says it remains to be seen how those interested in electric lighting will receive this blunting of one of their favorite weapons of attack, and then proceeds to show that the blunting is not as serious as at first seems. The tests were made in cold weather, which, it is evident from the tests, is more favorable to gas. Similar tests during the summer might show different results.

It is to be noted that the differences found between the two systems of lighting were slight and neither one was as important a factor in determining the conditions in the room as the occupants themselves. Such conditions are not favorable to accurate differentiation between the effects of the two lighting systems. The tests were conducted in a steel-framed structure which dissipated seventy-two per cent of the heat by conduction and radiation and the results are not applicable to buildings of other types. Moreover, the two systems of illumination were used alternately so as to avoid differences resulting from the use of the two rooms without change. If the object of the investigation was to detect differences between the two systems of illumination it would seem logical not to alternate in this way and to let the differences accumulate. It is not customary to vary one's system of lighting as was done here. Another point to be remembered is that the tests were conducted with incandescent gas lamps and the results do not apply to open burners.

Dr. Rideal's results are interesting, but not entirely convincing, and further tests will have to be made before it can be said that the superiority of gas has been demonstrated. It would be well if some of those interested in electric lighting should undertake similar investigations under somewhat different conditions. We should be much surprised if some of these tests, should they be made, do not show quite different results. As we remarked before, the electrical advocates' theory is sound and it only remains to show how far it applies in practice.

DANGEROUS HAND LAMPS.

A recent report, prepared by Mr. G. S. Ram, inspector of factories for the British Board of Trade, calls attention particularly to what seems at first a slight defect in electrical hand lamps, but which the inspector says has already caused three fatal accidents. These are electrical hand lamps attached to a flexible cord, with a wire guard for protecting the bulb. The guard is very frequently attached to a metal base, clamped upon the lamp sockets. The cord itself is usually, for convenience, passed through a hole running through the insulated handle. The trouble with this device is that occasionally the metal plate

supporting the guard becomes alive, due to some injury to the insulation of the wire. The guard is, of course, in metallic connection with the socket, and is alive whenever the latter is. And, although the user of the lamp would avoid touching the socket, he is not apt to anticipate danger in touching the guard. Sometimes, indeed, the socket is attached to a brass ferrule, which seems to form part of the handle, and which the uninitiated would not consider part of the socket, although it is metallically connected thereto. It was just these faults which gave rise to the three deaths referred to above.

This defective construction should never be allowed because of the risk when such a device is used on alternating currents. The fault is easily corrected by supporting the wire guard on an insulating plate or shell, thus avoiding any metallic connection whatever in the pocket. There are a number of such arrangements available, one of which should always be adopted. The reason is so apparent it would hardly seem necessary to call attention to it, if the defective arrangement had not actually been the cause of death. It may be added that it is just as important to avoid an arrangement which is likely to bring the hand of the user of the lamp in contact with the connecting wire, when the arrangement of the handle is liable to injure the insulation of the wire. We are apt to forget that even though the actual potential at the lamp is low, it is possible by a combination of defects for a high potential to exist between the lamp and the ground if the system of distribution employ alternating currents.

ILLUMINATION AND OUR EYESIGHT.

In an interesting editorial discussion our London contemporary, *Engineering*, takes up the possible effect upon our eyesight of the brilliant illumination which is now so much in popular favor. The introduction of powerful electric incandescent lamps, fitted with metallic filaments, has increased the complaints from those who see in the intense brilliancy of the newer forms of lamp a lurking danger. It is conceded that with the improvement in our newer forms of incandescent lamps we have been receiving more and more ultra-violet rays. In many cases where the light source is surrounded by glassware more or less opaque to the ultra-violet rays, this effect has been masked, and has lessened what, in some quarters, is considered a danger. It is well known, however, that experimenters working with metallic filaments at a point of high incandescence have been affected by severe irritation of the eye and eyelids, and this effect has been set down to the prevalence and activity of the ultra-violet rays. Coincidentally, the effect has been noticed where the filaments have been encased in quartz glass tubes, the quartz glass being, of course, more transparent to the ultra-violet rays than is the glass from which the ordinary lamp bulbs are made. Both the crystal lens and the retina of the eye are said to be affected by ultra-violet rays, and it is also announced that a good many of our protective spectacles are of little value. Dr. Fr. Schanz and Dr. C. Stockhausen regard the ultra-violet rays as a source of danger, and point to the experience of several operators as conclusive testimony to this effect. On the other hand, Dr. Voege, of the physical government laboratory, of Hamburg, after conducting numerous photographic experiments to determine the abundance of the ultra-violet rays in our modern illuminants, as compared with sunlight, states that the danger is exaggerated. The chief results of Dr. Voege's experiments would seem to indicate that the ultra-violet rays are more plentiful in the sunlight than they are in various forms of incandescent illuminants, with a few exceptions. His experiments, however, are all photographic, and the eye certainly, as far as we can determine, is not sensitive in the same order as is the sensitized plate.

Direct photographs of the spectra of various lamps and of the sunlight taken through the slit of a spectrograph gave a much longer ultra-violet spectrum in the case of sunlight than any lamp, and the interposition of a screen of window glass did not much alter the result. Even the sunlight reflected from the slabs of sandstone stairway was richer in ultra-violet light than the electric light. Dr. Voege concludes that the eye receives less ultra-violet light from the lamps than from the direct sunlight, but makes suggestions concerning the shielding of the eyes from the direct light of the former.

What the real danger is still remains to be discovered. Fortunately, we are not inclined to gaze directly upon the glowing filament, and in most modern illumination good taste demands that the direct light from the filament be diffused by means of some form of semi-opaque glassware. The experiments which have been announced by the workers just mentioned, and their results, will be watched for with keen interest by every one having to do with the subject of illumination.

The whole subject of the effect, whether for good or evil, of the invisible radiation, is worthy of continued study. The early practitioners with the X-ray found to their cost that careless handling caused disastrous results both to the operators and to the patients subjected to the photographic influences of the Roentgen ray. Nowadays the danger has been eliminated, due to the scientific use of filtering screens and the shortening of the time necessary for a complete and satisfactory exposure. There are also many well-authenticated cases of burns from the invisible radiation from radium emanations, and the penetrating power of these rays, too, was discovered accidentally. These accidents and such work as is being conducted by Drs. Schanz, Stockhausen and Voege indicate that wherever the invisible radiation is involved, or where there is good reason to suspect that it is present, care should be taken to guard against damage in so far as our present methods of protection will insure possible safeguards.

In still another direction comment is raised, and a warning is sounded that the etheric impulses propagated through the use of wireless telegraph systems will have a deleterious effect upon living organisms. Of course a good deal of this will doubtless prove to be visionary, but that certain effects are produced upon certain forms of anatomy appears to be assuredly a fact. It is to be hoped that further investigation will make us so familiar with cause and effect that we can detect, arrest and utilize to the service of man these elusive and at present hidden forces.

CORROSION OF IRON FROM THE ELECTROCHEMICAL STANDPOINT.[1]—I.

BY C. F. BURGESS.

Depreciation is a subject which is today occupying the attention of financiers, economists and accountants. It is one which presents various phases, none of which is more important than those of obsolescence and physical decay. For one of these the engineer may be held responsible; the other he should work to prevent. Obsolescence comes as a direct result of new discoveries in science and their adaptation to man's use. Physical decay apparently follows the working out of nature's process, yet it has been proved possible for the scientist and engineer largely to reduce the rapidity with which such decay progresses.

In the use of iron as the most important structural material, attention has been given hitherto more to design and erection than to preservation, but as the amount of erected iron increases, the importance of preserving it likewise increases. The older our existing iron structures become, the greater is the need of retarding their decay.

The phenomenon of physical decay of iron and its alloys has long been known, but is little understood. To control it a deeper knowledge of the underlying causes is necessary. When we recognize the fact that iron structures depreciate annually in value through physical decay at a rate varying from perhaps one per cent to twenty or more per cent we have a means of stating the importance of this in money units. When viewed from the standpoint of safety to life, as well as that of preservation of property, the matter takes on a far greater significance.

The importance of this subject from economic, socialistic, governmental and humanitarian standpoints should be sufficient to enlist interest in the work, quite aside from the fascination which it exerts in itself. As Sir Robert Austen has said, "The study of metals possesses an irresistible charm for us quite apart from its vast national importance. Metals have been sadly misunderstood; in the belief that animate beings are more interesting experimenters have neglected metals, while no form of matter in which life can be recognized is thought to be too humble to receive encouragement. Bacteria with repulsive attributes and criminal instincts are petted and watched with solicitude and comprehensive schemes are worked out for their development and culture."

Corrosion of iron may be considered as the generic term covering a number of diseases peculiar to iron and iron alloys. So little is understood as to the causes of even the most common of these diseases that to prescribe for them requires considerable assurance on the part of the experimenter. There is an insistent demand at the present time for further experimental study of corrosion and for the gathering of accurate records on corrosion phenomena.

Some of our leading authorities hold that primarily iron corrosion is an electrolytic phenomenon. Such a view was advanced by W. R. Whitney (Journal American Chemical Society, 1903, page 394) and this was corroborated and notably extended by W. H. Walker (Journal American Chemical Society, 1906, page 1251). A. S. Cushman, through some interesting experiments described to our society last year, also sought to ascribe corrosion to electrolytic action.

The acceptance of such a belief would place upon the electrochemist the first responsibility of making a thorough study of iron corrosion, and it is certainly true that such research would offer him a most attractive field for work.

In viewing corrosion of iron as an electrochemical action, it may be desirable to divide into classes various kinds of corrosion encountered in practice. The first class to be considered is:

CORROSION OF UNDERGROUND STRUCTURES.

It is well known that under normal conditions, iron pipes buried in the earth for distribution of gas and water will corrode so slowly that the life may well exceed a century. The owners of such pipes were greatly disturbed not many years ago to find that a disease had been contracted by their pipes, presumably through association with electric railways. They attempted, and are still attempting, to demonstrate to the courts that the railway companies are responsible for damage caused to their pipes by the leakage of currents from the railway returns.

It has been shown beyond doubt that current flowing from iron to earth subjects the iron to electrolytic corrosion, but beyond discovering methods for mitigating the destruction, the electrochemist has not succeeded in freeing from electrolytic trouble pipes located near a single-trolley railway.

This phenomenon has attracted such attention that to many people the term "electrolysis" is synonymous with destruction of underground pipes. In spite of extensive study which has been given to this matter it is interesting to note various curious beliefs which are held even by some of the experts. Thus we have the disputed point as to whether current flowing from iron to earth will cause a quantitative corrosion as required by Faraday's laws; some hold that the earth conducts to a certain degree metallically, and therefore a small current density may not cause any corrosion whatever; while others assert, and probably more correctly, that Faraday's laws hold exactly for large and small currents alike. Testimony has been given to the effect that the flow of current through the earth results in the deposition of a coat of iron upon pebbles in the earth, a phenomenon certainly of interest to those who have experienced the difficulty of depositing iron under most favorable conditions upon a conducting cathode. The statement is repeatedly made that current flowing from the rails to the pipes does not produce electrolysis, but that current flowing in the reverse direction is dangerous. This, of course, is only another case of "whose bull is gored."

In the study of this type of corrosion the electrochemist is called upon to clear up erroneous beliefs by quantitative measurements. So far remedies applied have been qualitative rather than quantitative, and before accurate work can be done in treating this trouble a large amount of data must be available; such as the specific electrolytic conductivity of various earths, clays, gravels, etc. The minimum electromotive force for flow of current must be more carefully studied to determine whether an electromotive force, no matter how small, will cause electrolysis, or whether polarization is to be counted upon.

Some authorities assert that if the direction of the flow of current can be reversed occasionally the electrolytic corrosion of both electrodes may be prevented, the argument being that current flowing from the iron will carry iron in a solution and that some iron will be redeposited when the direction of the current is reversed. This remedy has been attempted in the operation of certain electric railways by reversal of the polarity of the generators once a day or every hour, or even more frequently, and the observations made during such practice led to the conclusion that the more frequently the reversals are made the less is the danger from electrolysis. In fact, when we carry this practice to its extreme

[1] From the presidential address before the American Electrochemical Society, Albany, N. Y., April 30.

limit and have a reversal several times a second we arrive at alternating-current transmission, the advent of which is generally assumed will be an absolute cure of electrolytic troubles, although some experts assert that an alternating-current system of distribution will not remedy present difficulties. The writer's experience in depositing iron from a solution even under the most favorable laboratory conditions has led him to believe that the chance conditions to be met with in the earth are not unlikely to make it possible to deposit iron from the earth on to the metallic electrode. Consequently relief from an occasional reversal of the current does not appear practical of attainment. This statement may not apply, perhaps, when the frequency of reversals is so rapid as to make the current come under the classification of alternating current.

GALVANIC ACTION.

Iron in contact with a metallically conductive material electronegative to itself, and both making contact with an electrolyte, constitute an active electrochemical system in which the iron is subject to corrosion. The rate of corrosion depends upon the electromotive force, upon the conductivity of the electrolytic and metallic conductors, and upon the polarization. If the electrolyte is such that the hydrogen is liberated on the electronegative surface it may produce polarization sufficient to stop the flow of current. If a depolarizing material be present the polarization will be decreased and the increased current thereby produced results in increased rate of corrosion. (Walker *et al*—Journal American Chemical Society, 1906, page 1251.)

As examples of an electrochemical system of this type, the following well-known cases may be named: An iron ship in a harbor with a copper-sheathed ship are considered undesirable companions, since if metallic contact be made between the two, the iron suffers by being made the anode of a huge electrochemical system of which the copper ship is the cathode and the sea water the electrolyte. It is not good practice to attach a bronze propeller on a steel shaft of sea-going ships, for unless suitable protective steps are taken the neighboring steel will be damaged.

The more electronegative the material the more marked is the electrolytic action, and some forms of conductive carbon have properties such as to make the electrolytic action particularly pronounced. Various investigators have pointed out that carbon cinder embedded in an iron surface, or carbon making contact with iron in any way, engenders corrosion by galvanic action. This action takes place whether the piece of iron is of large or small size, and the kind of action produced by particles of microscopic size is identical with that produced by the large particles. The uncombined carbon which chemical analysis shows to exist in certain kinds of iron may therefore increase the corrodibility of such iron. The measurement of the single potential of iron sulphide shows this to be electronegative to iron and its presence in iron will give rise to active couples. It can hardly be doubted that such surface exposing spots of iron sulphide is one upon which electrolytic action will take place if an electrolyte be present.

Almost any microphotograph of iron and its alloys shows non-uniformity of composition of surface exposed to corrosion, and we are justified in the belief that the micrographic constituents should be studied in dealing with iron corrosion from the electrochemical standpoint. We do not know in what electrochemical order the ferrite, pearlite, cementite and other constituents of iron alloys may arrange themselves. Data as to the single potential of these various constituents are needed if we would express quantitatively the tendency of a certain combination to corrosion. At the present time our only knowledge of these potentials is of a qualitative kind and also very fragmentary. The available published data come from the records of the work done by the metallographists in their microscopic study of iron. Highly polished iron surfaces have been treated with various corroding acids and reagents, the purpose being to corrode the different constituents at different rates under the microscope. A study of the literature on metallography for the purpose of classifying these observations might constitute interesting and valuable work.

It is perhaps doubtful if the exact measurement of any one constituent could be made, at least with the present method of measurement, since in measuring the electrical potential of an iron or iron alloy, a value is obtained which may be the electromotive force given by the most positive constituent, or it may be that produced by the polarization phenomenon, or it may be some intermediate or composite value. W. H. Walker and associates (Journal American Chemical Society, September, 1907) have devised an ingenious method for determining the different potentials established by different portions of an iron surface, and they have shown "that in certain instances areas having marked difference in potential exist in far greater number upon the surface of a piece of iron prone to corrosion than upon iron which is resistant to corrosion." Whether this method would lend itself to the measurement of microscopic portions of an iron surface is problematical. An active electrochemical system can usually be detected wherever corrosion is observed, but whether corrosion can exist where no electrolytic action is possible is a matter which appears far more difficult to determine.

Assuming a similarity in chemical composition and metallographic constitution in different samples of iron or iron alloys the question may be asked, "Can the single potential differ in different specimens or different parts of the same specimens?"

INFLUENCE OF STRAIN ON CORRODIBILITY.

Does strain in iron increase tendency to corrosion? This is a question which has been the subject of interesting discussion and upon which there is radical difference of opinion. Data obtained by different investigators are quite contrary, and it is natural then that contradictory conclusions have been drawn.

In referring to those radically different conclusions of different experimenters the writer disavows any desire to enter into a controversy. But it appears that unless errors which are allowed to creep into methods of measurement are recognized and then guarded against, the data obtained can be of little value and these errors can perhaps be detected by comparison of the methods employed by different observers.

As a matter of scientific interest we may refer to that well-known riddle which runs as follows: Two steel clock springs are identical as to weight and quality of material, and differ only in that one of the springs is coiled and the other uncoiled. These are immersed in an acid solution and completely dissolved. What has become of the energy which was stored up in the coiled spring? The answer which most easily suggests itself is that this energy must have been liberated during the chemical process of solution and manifested itself as heat. Upon this supposition in dissolving the coiled spring more heat would be liberated than in dissolving the uncoiled spring. Further, the coiled spring would be more chemically active, and if so this chemical activity should be manifest as increased electrical

contact potential existing between the metal and the solvent.

There are many instances coming under practical observation which seem to bear out the idea that a metal under strain is more subject to a dissolving or corroding action than is unstrained metal, this relation being particularly true in iron and its alloys. Mr. James Andrews in 1894 (Proceedings of the Institution of Civil Engineers) described some experiments by which he attempted to demonstrate that strained iron has a higher potential in a corroding solution than has unstrained. He concluded, however, from the results of his measurements, that the reverse condition holds, and that unstrained metal is more rapidly acted upon by the solution than the strained metal. Mr. Carl Hambuechen in 1900 (Bulletin of the University of Wisconsin, Engineers' Series) pursued an investigation which was, in a measure, a duplicate of that made by Mr. Andrews, with the exception that Hambuechen sought to eliminate some error in the former work by modifications and refinements in the method of measurement. He produced experimental data showing that the iron behaved as it should according to theory, and in fact he was able to secure, in some cases, a remarkable similarity of stress-electromotive-force diagrams with the stress-strain diagrams obtained simultaneously on the same sample. He says, "The application of stress to metal causes an increase in chemical activity, this increase being especially marked after the elastic limit has been reached."

In 1906 T. W. Richards and G. E. Behr, Jr., contributed a paper to the Carnegie Institution of Washington, publication No. 61, entitled "The Electromotive Force of Iron Under Varying Conditions and the Effect of Occluded Hydrogen." This paper asserts the presence of regrettable errors in Hambuechen's work, and among the conclusions it is stated that "measurements of the free-energy change in iron during a pull upon wire great enough to cause rupture gave results showing that this change must be very small." The authors apparently conclude from their work that the changes in electromotive force actually produced are too small and the data too scanty and irregular to warrant conclusions of value being drawn. This view apparently places Hambuechen's data under the charge of accidentally falling into a systematic order, which order would not have been shown had the alleged errors been avoided.

In 1907 Messrs. W. H. Walker and Colby Dill discussed "The Effect of Stress Upon the Electromotive Force of Soft Iron" before the American Electrochemical Society. In their summary the statement is made that "the magnitude of the potential suffered by soft iron when tested in a tension machine below the elastic limit is exceedingly small. . . . The change, when great enough to be measured, was negative; the strained metal had a slightly lower potential than the same metal unstrained. . . . . Somewhere above the elastic limit the potential rises suddenly several hundredths of a volt."

It may perhaps be not unprofitable to enter into a consideration of the cause of the marked differences of the results obtained by different observers and the diametrically opposite conclusions which were drawn therefrom. Of the various authorities mentioned, Hambuechen has apparently secured results which uphold that plausible theory that iron upon which mechanical work has been done retains some of the energy in a potentialized form capable of being measured by electromotive-force readings. The other authorities discredit these results. It is probable that none of the results referred to have been obtained under conditions which are free from all sources of error. Hambuechen's work was done under the supervision of the writer, who therefore feels justified in discussing some criticism of his methods and conclusions. Mr. Hambuechen pointed out in his bulletin that chances for error existed in Andrews's work by reason of the fact that the surfaces whose potential was being measured were not protected from action of the air. He devised a cup-shaped arrangement which surrounded the sample of iron in the testing machine and carefully protected all of the parts of the iron from the air and the electrolyte except such portion of the surface as was kept immersed in the electrolyte and whose potential was being measured. He recognized that the amount of potential changes was exceedingly small and that the potential established by a metal in contact with an electrolyte is easily upset by the flow of exceedingly small amounts of current. The use of an ordinary galvanometer used in connection with the compensation method was believed to allow the flow of sufficient current to materially polarize the small surface under measurement. He therefore used a capillary electrometer, which acts as a condenser of small capacity and does not allow the steady flow of current through it. This electrometer had a sensitiveness of 0.0007 of a volt, and in addition to this sensitiveness it was unaffected by vibration and magnetic disturbances and could be mounted in close proximity to the testing machine.

Messrs. Richards and Behr employed a D'Arsonval galvanometer sensitive to 0.001 volt, and they apparently did believe it necessary to guard fully against polarization phenomena. Walker and Dill likewise took this view as to the precautions deemed necessary, for they employed a D'Arsonval galvanometer of fairly high resistance but provided with a shunt "to protect the galvanometer from too heavy currents during the preliminary adjustment of the resistances."

In both papers referred to, that by Richards and Behr and by Walker and Dill, objection is made to Hambuechen's results on account of his use of ferric chloride as the electrolyte against which the potential of the iron was determined. The former writers say that "this unfortunate choice" (of ferric chloride) "completely invalidates all the results. The reason is very simple. Ferric chloride is always hydrolized to a considerable extent —that is, it contains acid. . . . . There exists in the electrolyte a continually changing concentration of ferric, ferrous and hydrogen ions and reliable work is out of the question. The effect of these influences combined would cause the electromotive force to change steadily, quite independently of any stress and strain effects." Data are given showing that in two cases the electromotive force of iron rose 0.192 and 0.123 volt in about seventeen hours, and they say that this rise would have been ascribed by Hambuechen to strain.

While it is perhaps true that a solution better than ferric chloride might be chosen, the criticism of Hambuechen's work for this reason is perhaps too severe, since he did recognize the fact that the electromotive force was subject to change, regardless of any strain effect. The change becomes so slow after a half-hour that a stress-strain diagram could be run through in a sufficiently short time that the natural change would have little effect in masking the changes produced by strains. In fact, in producing autographic record of the stress-strain diagrams the testing machine was run continuously and the electromotive-force measurements had to be taken with some rapidity. The writer believes that these observations of varying electromotive force are more probably the results of

potentialized energy in the iron than the effects of hydrolysis of the ferric chloride solution, as emphasized by Richards and Behr.

The feature which at first sight might discredit more than any other the accuracy of Hambuechen's results is that he found changes in electromotive force which were materially greater than those calculated on the assumption that all of the energy applied to an iron rod in pulling it apart is thereby potentialized.

Barus has studied the disposition of energy applied in rupturing a piece of iron. ("The Energy Potentialized in Permanent Changes of Molecular Configuration," United States Geological Survey Bulletin, No. 94, 1892.) And quoting from him we read: "To summarize, it appears that as much as one-half of the work done in stretching up to the limit of rupture may be stored up permanently. Calculation of the increase of electromotive force by the potentializing of energy in iron involves the application of the formula

$$E = \frac{W \times c}{96540 \times g}$$

where

E is increase of electromotive force in volts.

W is energy stored, expressed in watt-seconds.

c is the chemical equivalent.

g is weight in grammes of the iron in which the energy is stored.

From measurements of stress and deformation Hambuechen calculated that the possible increase in electromotive force on a particular sample was 0.0126 volt (on the erroneous assumption that all of the applied energy was potentialized). He found in some of his measurements values two or three times as high as were apparently theoretically possible, to explain which he assumed an excessive storing of energy in the outer layer of iron as compared with that at the centre. Richards and Behr were justified in considering this an erroneous assumption. They have apparently overlooked the possibility, however, of a non-uniform distribution of such energy as may be potentialized by strain, for in their calculations of electromotive force they have assumed the energy to be equally stored in all particles of the sample of iron.

Ewing and Rosenhain, in a paper on "The Crystalline Structure of Metals" (Philadelphia Transactions, Royal Society, Vol. cxciii), have given results of microscopic study on the effect of strain on metals. It is well established in their work that the influence of strain is not uniformly distributed throughout the mass. It appears that the shape of the grains is altered, but that the crystals making up the grains are not deformed. "The conception that metals adapt themselves to the new shapes imposed upon them when they undergo plastic deformation by means of slips along cleavage or gliding planes within each crystalline grain leads naturally to the supposition that the crystalline elements themselves undergo no deformation in the process."

Energy is expended in overcoming the adherence or attractive force between crystals, and if there is a storage of this energy it might well be considered as being stored in the portion of metal adjacent to these surfaces. As this metal, containing potentialized energy, is exposed to the electrolyte, the electromotive force of this portion will be greater than that of the remaining portions. To calculate this electromotive force according to the formula given requires a knowledge of the actual weight of that portion of the metal in which the energy is stored, which obviously would be less than that obtained by weighing the entire mass. This weight is, of course, impossible to determine by known methods of measurement.

The electromotive force of the most electropositive particles is then greater than the average electromotive force calculated. The question then arises as to which value—the maximum, the minimum or average value, or some value of overvoltage of hydrogen—is obtained by experimental measurement of contact potential. Richards and Behr have described their determination of the single potential of small globules of iron around which were wrapped platinum wires to make contact. Their voltages are given as being the values for iron even though it is in contact with the more electronegative platinum. Likewise we have in a zinc amalgam the electromotive force of the zinc almost unaffected by the electronegative mercury. From analogy we might expect, therefore, that the potential would be that set up by the most electropositive particles on its surface. And if this line of reasoning is correct, we can easily explain why Hambuechen's measured values of electromotive force were higher than those calculated, and we may perhaps wonder why the differences were not even greater than found.

It should be recognized, in comparing the results of different investigators, that the materials designated as iron may, in fact, be different grades of iron. Richards and Behr confined their attention to highly purified iron, while Hambuechen used the term more loosely as designating the commercial grades of the metal. He found that the increase of potential by strain is more marked in steel than in pure iron, and a microphotograph of steel reveals the presence of various constituents. In all probability there is a difference in the storage of energy in the various constituents, and consequently the possibility of higher electromotive forces.

It may be emphasized again, and in this connection, that the microscope is a useful device in studying the phenomena pertaining to the corrodibility of iron.

(To be concluded.)

Semiannual Meeting of the National Association of Cotton Manufacturers.

The semiannual meeting of the National Association of Cotton Manufacturers will be held at Saratoga Springs, N. Y., September 29 and 30. The sessions will be held in the ballroom of the United States Hotel at 10 A. M., 2.30 P. M. and 8.15 P. M. on Tuesday, and at 8.15 P. M. on Wednesday. The fore part of Wednesday will be devoted to an excursion to the works of the General Electric Company at Schenectady, as guests of that company.

A programme has been arranged with fewer papers than usual in order to provide ample time for discussion. Among the papers to be presented are several which will bear directly upon the use of electricity in the textile industry.

The Textile Exhibitors' Association will hold its annual meeting at Saratoga Springs on September 29, and at this meeting officers will be elected for the ensuing year. Plans will also be made for a textile exhibit in the spring of 1909.

The officers of the National Association of Cotton Manufacturers are as follows:

President — Charles T. Plunkett, Adams, Mass.

Vice-presidents—George Otis Draper, Hopedale, Mass.; Franklin W. Hobbs, Boston, Mass.

Secretary and treasurer—C. J. H. Woodbury, Boston, Mass.

Auditor—C. E. Roberts, Boston, Mass.

Directors—Robert Beatty, Philadelphia, Pa.; Frederick A. Flather, Boston, Mass.; George P. Grant, Jr., Fitchburg, Mass.; Edwin Farnham Greene, Boston, Mass.; David S. Johnston, Cohoes, N. Y.; John W. Knowles, New Bedford, Mass.; William H. Loftus, Newark, N. J.; Henry F. Mansfield, Utica, N. Y.; Joseph Merriam, Middletown, Ct.

A Twelvemonth's Achievement of the Tungsten Lamp.

By S. E. Doane, Chief Engineer, National Electric Lamp Association.

THE past twelve months has marked the greatest progress in the history of artificial lighting. No epoch equal to it has ever been known. The advent of the incandescent lamp itself was possibly a greater scientific achievement, but no one period of time since has marked so great a change or benefit to the general public.

The carbon lamp created a field for itself. The tungsten lamp found the field created.

The carbon lamp was put into service with many frailties, whereas the latest unit was given to the world as a product of splendidly equipped laboratories and workshops where the testing and perfecting had all been done. The customer was made to suffer from the mistakes of the manufacturers of the early carbon lamp. This has not been the case with the tungsten. The new lamp from the first has outstripped its guaranteed performance and nowhere has there been a single failure of this lamp to fulfil all expectations.

The Nernst and Gem lamps were perfected several years too late, to have been fully appreciated. It is also a pity that the achievement of the tantalum lamp should have been so quickly superseded by the greater achievement of the tungsten.

The last twelve months have seen general recognition of the fact that the enclosed arc lamp is being superseded for interior lighting, while the Nernst lamp is entering upon this stage of its history.

The carbon lamp is still holding its own in quantity of production. Its rate of increase of production has been materially decreased and at no distant day the replacement of carbon lamps by tungsten will offset the new installations where the carbon lamp should legitimately be used.

It was inevitable that the first shock of the tungsten lamp introduction should occasion much anxiety on the part of the central station managers, but there is now to be noticed the most gratifying optimism on the part of the central stations. Many now report that the tungsten lamp has actually served to increase their revenues. From this time on, it is my belief, that these conditions will continue to prevail.

The central station has seen its worst days so far as decrease of revenue through the tungsten lamp is concerned. It was inevitable that stores and other places of a public or quasi-public character should have been the first to have employed this lamp, due to the fact that the first development of this lamp was in the units of larger candle-power, to which the fixtures in residences were not adapted. Central stations have suffered in revenue where public or quasi-public employment has maintained the volume of light which was sufficient, according to the old standard, with a decrease in current revenue to the station. This condition of replacement was continued for some months, but the progress of the country's recovery from its financial stagnation will now turn the tide.

Although replacement of carbon type lamps with tungsten in such places will continue, nevertheless, the opening of new fields and the general increase in the standard of illumination in such places will offset the decrease in current revenue from the places where illumination is already sufficient and also where the tungsten lamp replaced the carbon.

The next great field for the introduction of the tungsten lamp will be in domestic lighting. Light in public or quasi-public places is a necessity and is regarded as such, but, as with every other necessity, economies of the situation have to be largely considered. The tungsten lamp would have been adopted even at a higher price on account of the improved quality of the light. No up-to-date store can afford to be illuminated by anything else. The quality of light from an arc lamp can be made extremely good, but its flickering character, its comparative clumsiness of installation, its failure to conform well to artistic and architectural requirements, are such that the tungsten lamp has found it an easy competitor.

In the case of domestic lighting, electric light as employed to-day is not a necessity, but is a luxury. The domestic users of electric light are those who are willing to pay something for luxury. The tallow candle and the kerosene lamp are to-day cheaper sources of light, yet the general improvement in the standard of domestic livelihood demands electric light and it is my belief that the advent of this tungsten lamp brings the day of universal electric lighting nearer than any one event in the history of the electric lighting industry. The tungsten lamp is already recognized by the architect and decorator of this country as offering them an opportunity for larger and more artistic color schemes and decoration than have before been possible. Interior decorators with whom I have talked tell me that there is already a noticeable change and that the interiors of public buildings are being tinted to take advantage of the new opportunities. These conditions will likewise shortly prevail in domestic incandescent lighting.

There is another most important consideration in connection with the introduction of tungsten lights in the homes, and this is that the average individual who must divide up his income, living in the best quarters that his income will permit, and undertaking only such amusements as his income will allow, has been obliged to limit his expenditures for light on the same basis. The tungsten lamp will make light cheaper for him as well as giving him a quality of light by which he can better enjoy the furnishings of his home. The effect of this is going to be that the domestic user will use light for longer hours and inasmuch as the tungsten lamp, for the same illumination, will take much less current, the result is going to be that the peak load due to domestic lighting will be greatly changed. It is fair to call attention to this under the subject given me for this article inasmuch as the twelve months passed have already marked the beginning of this change. Residences will be more generally illuminated and instead of lamps being installed with many switches for the sake of economy in operation, the contractors will, in the future, arrange for rooms more generally and continuously lighted throughout the period between twilight and bedtime. This will result in increasing the demand factor and also the load-factor for our central stations with a result that they will be able to decrease rates, which, in itself, will again stimulate the introduction of the tungsten lamp.

Many practical problems have been met and solved in the last year. We now no longer hear of the great fragility of the tungsten lamp. Much of this has been due to increased knowledge in the laboratories by which the filaments have been made stronger. At the same time, the customer himself has learned how to handle this lamp. Breakage in shipment to-day is less than one-half of one per cent. While it is to be regretted that the lamp is as fragile as it is, a general

recognition of this fragility, together with an improvement in the strength of filaments, has almost removed the question of breakage from a consideration of adoption of this lamp. Scarcely twelve months ago there was not a single well-equipped, well-established tungsten lamp factory in the United States; to-day there are several with a combined capacity of 75,000 lamps a day, and at present a combined daily output of 25,000 lamps. Prompt deliveries are being made by all tungsten manufacturers.

The next twelve months will see a rapid introduction of train-lighting lamps and other battery users for this lamp. The maker of the storage battery has begun to profit much from the demand for tungsten lamps of low voltage at various candle-powers.

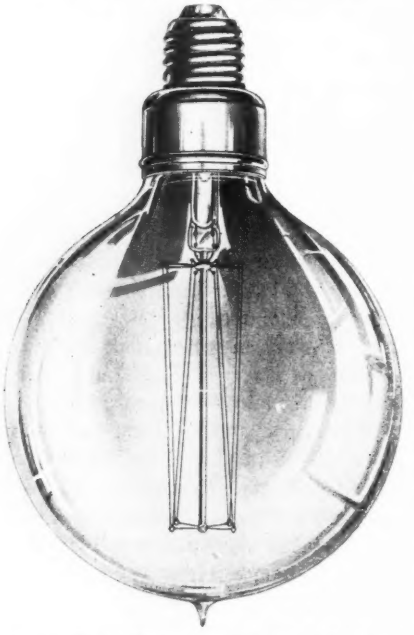
Great as has been the progress in the manufacture and production of this lamp in the past twelve months, an even greater progress awaits it in the twelve months to come. The industry is to be congratulated that the shock of the first introduction of this lamp has been so well met.

There will be other progress in the future. The problem of selective radiation, which the tungsten lamp has so well opened up, will be solved to a greater or less extent in the near future and a comprehensive and serious effort on a considerable scale has been inaugurated for the thorough scientific study of this and other problems underlying our industry. We look for much progress from such work.

Tungsten Lamp Economy.

By Francis W. Willcox.

RARELY does the evolution of an art culminate in such a simple device as the incandescent lamp, and in the case of the tungsten lamp the future appears to hold no prospect of undermining its supremacy as a lighting unit, but on the contrary promises to make its position stronger by increased efficiency.



SIXTY-WATT MERIDIAN TUNGSTEN LAMP.

The arguments in favor of the electric incandescent lamp have long made it the standard to which all other illuminants have aspired, but the question of cost enabled its competitors to maintain a strong position in the field. The tungsten lamp distances in average efficiency its strongest competitor, gas, and, ideal in every other respect, places the best illuminant within the reach of all.

MANUFACTURING FACILITIES.

During the year that American-made tungstens have been on the market appreciation of their qualities has been shown by an enormous increase in their sales. Anticipating the demand, the manufacturers have kept pace with their orders after the first few months, and in the immediate future 75,000 per day will be the capacity of American factories, one manufacturer alone advertising facilities for nearly half this number. The economy, brilliancy and general satisfaction given by the tungsten lamp make every one of them a salesman, and the 1,000,000 American-made lamps now giving satisfactory service are dominating factors in the demand for their increased adoption.

RECENT IMPROVEMENTS.

Improvements in the tungsten lamp have been numerous during the year. Specially designed packing cases have reduced breakage in shipment to an almost negligible quantity—out of 100,000 lamps shipped by the company with which the writer is connected less than one and one-half per cent were lost, and damage from careless handling has naturally been eliminated by a realization of the caution required in installing. While the pendent position is recommended, tungsten lamps as now made give excellent results when burned at any angle.

The twenty-five-watt tungsten for standard lighting circuits is still a thing of the future. Until it is perfected, however, the twenty-five-watt tantalum lamp, which has proved commercially satisfactory on alternating-current circuits, is making an excellent substitute.

THE 250-WATT TUNGSTEN.

At the other end of the scale the new 250-watt tungsten is making a phenomenal record. This lamp of 200 candle-power replaces gas arcs or electric arcs, lamp for lamp, and with considerable saving in operating expense entirely apart from increased safety, convenience and the other inherent advantages of the incandescent lamp.

The cost per candle-power naturally becomes less as the size of the unit increases, while the saving per unit of illumination remains the same (2.25 watts saving per candle-power when compared to a 3.5-watts-per-candle carbon lamp).

As compared to carbon lamps for equal illumination the forty-watt tungsten saves enough at ten cents per kilowatt-hour to pay for itself three times over, but the 250-watt lamp saves enough to pay for itself eight times over. Furthermore, the 250-watt filament is much thicker and stronger than in the smaller sizes. It is a happy coincidence that this lamp, which is the most active factor in replacing the strongest competitors of the incandescent lamp, should be the sturdiest, and therefore least subject to, perhaps the most frequently mentioned argument against its use—the bugbear of fragility.

GENERAL ELECTRIC 250-WATT TUNGSTEN INCANDESCENT LAMP.

OPERATING COSTS.

The basis of all comparison is the actual saving in watts per candle-power of light, but the cost of the lamp and its life are necessary factors in making a correct commercial investigation of the tungsten lamp's merits.

The accompanying table has been compiled from such general data, and may be found surprising in many of its items. Its most interesting feature, however, is found in the last line of the table, which shows that for the same number of candle-hours of light the total cost of power and lamps for carbon lamps is more than double that with tungsten lamps.

TABLE OF DATA AND COSTS FOR SERVICE WITH VARIOUS LAMPS.

	Carbon.			Gem.		Tantalum.	Tungsten.			
	16 C.P., 3.1 W.P.C.	16 C.P., 3.5 W.P.C.	32 C.P., 3.1 W.P.C.	20 C.P., 2.5 W.P.C.	40 C.P., 2.5 W.P.C.	20 C.P., 2 W.P.C.	32 C.P., 1.25 W.P.C.	48 C.P., 1.25 W.P.C.	80 C.P., 1.25 W.P.C.	200 C.P., 1.25 W.P.C.
Total watts	50	56	100	50	100	40	40	60	100	250
Hours life to 80 per cent rated candle-power	500	1,000	500	500	500	800	800	800	800	800
Cost of lamp	17¢	17¢	25.5¢	21.25¢	29.75¢	51¢	$1.23	$1.49	$1.70	$3.40
Kilowatt-hours during life	25	56	50	25	50	32	32	48	80	200
Cost of renewals per kilowatt-hour	0.68¢	0.30¢	0.51¢	0.85¢	0.595¢	1.6¢	3.82¢	3¢	2.11¢	1.7¢
Cost per 100 hours' service for power at 10 cents per kilowatt-hour	50¢	56¢	$1.00	50¢	$1.00	40¢	40¢	60¢	$1.00	$2.50
Total cost of power and lamps per 100 hours' service at 10 cents per kilowatt-hour	53.4¢	57.7¢	$1.05	54.3¢	$1.07	46.4¢	55.3¢	78.5¢	$1.21	$2.925
Candle hours during life	7,350	14,700	14,720	9,200	18,400	14,720	23,680	35,520	60,000	150,000
Cost of power per 100 candle-hours at 10 cents per kilowatt-hour	3.4¢	3.8¢	3.4¢	2.7¢	2.7¢	2.17¢	1.36¢	1.36¢	1.36¢	1.36¢
Cost of renewals per 100 candle-hours	0.23¢	0.12¢	0.17¢	0.23¢	0.16¢	0.35¢	0.50¢	0.41¢	0.28¢	0.226¢
Total cost of power and lamps per 100 candle-hours at 10 cents per kilowatt-hour	3.63¢	3.92¢	3.57¢	2.93¢	2.86¢	2.52¢	1.86¢	1.77¢	1.64¢	1.586¢

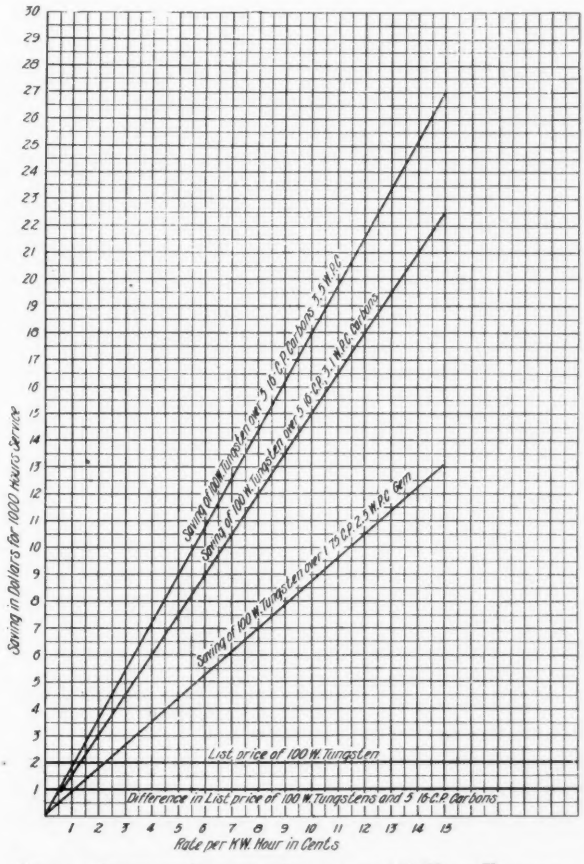

Saving in Dollars for 1000 Hours Service
Saving of 100 W. Tungsten over 5 16 C.P. Carbons 3.5 W.P.C.
Saving of 100 W. Tungsten over 5 16 C.P. 3.1 W.P.C. Carbons
Saving of 100 W. Tungsten over 1 75 C.P. 2.5 W.P.C. Gem
List price of 100 W. Tungsten
Difference in List price of 100 W. Tungstens and 5 16-C.P. Carbons
Rate per K.W. Hour in Cents

FIG. 1.—DIAGRAM SHOWING SAVING OF 100-WATT TUNGSTEN LAMP, AT EQUIVALENT CANDLE-POWER, OVER GEM AND CARBON LAMPS, AT DIFFERENT RATES PER KILOWATT-HOUR.

SOME STRIKING COMPARISONS.

Two diagrams are given herewith which illustrate the advantage of high-efficiency lamps, the eighty-candle-power, 100-watt tungsten being taken as the unit of comparison.

Fig. 1 shows the saving for equal illumination secured by the 100-watt tungsten over carbon lamps at various rates per kilowatt-hour. The curves are based on a life for the tungsten lamp of 1,000 hours and it will be seen at what an extremely low rate the tungsten lamp will pay for itself in saving of energy. Horizontal lines at the bottom of the diagram give the list price of the 100-watt tungsten and also the difference in list price between the tungsten and sufficient carbon lamps to give equivalent candle-power. The points at which the diagonal lines cross these horizontal lines give, respectively, the rates necessary for the tungsten lamp to save its entire cost and its extra cost over carbon lamps.

Fig. 2 is a comparison of the cost for 100 candle-hours' service of the 100-watt tungsten lamp, the 100-watt carbon lamp, the 100-watt Gem lamp and the forty-watt tantalum lamp at different rates per kilowatt-hour.

TUNGSTEN BATTERY LAMPS.

A very wide field has been found for the tungsten lamp in low-voltage and miniature types, where the high efficiency of the tungsten filament gives ideal results. In these lamps the low voltages permit the use of shorter and stronger filaments, and render the lamp able to withstand shocks and jars to much better advantage. In fact, they are being used extensively in automobile service, where the reduction of requisite battery capacity is of great value.

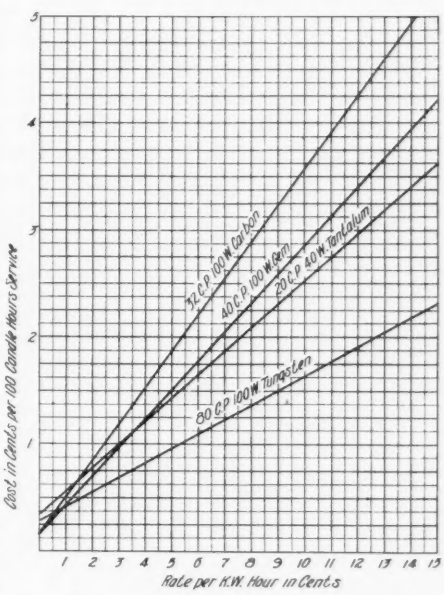

Cost in Cents per 100 Candle Hours Service
32 C.P. 100 W. Carbon
40 C.P. 100 W. Gem
20 C.P. 40 W. Tantalum
80 C.P. 100 W. Tungsten
Rate per K.W. Hour in Cents

FIG. 2.—COMPARATIVE CURRENT COSTS FOR 100 CANDLE-HOURS OF SERVICE WITH TUNGSTEN, TANTALUM, GEM AND CARBON LAMPS.

The efficiencies of the low-voltage and miniature lamps run from one to one and one-quarter watts per candle, with lives corresponding to those of carbon lamps of the same candle-powers and voltages. Besides giving three times the light of car-

bon lamps, the superior brilliancy and whiter color makes them much more desirable for many purposes.

In surgery the small tubular tungsten lamps give a more brilliant light and are cooler than carbon lamps.

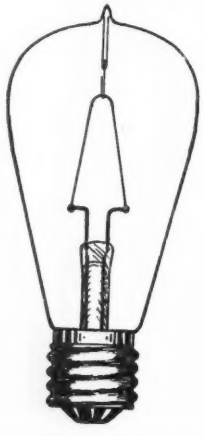
In automobile service small lamps for side lights, for tail lights, instrument illumination, etc., can be operated satisfactorily from the ignition storage battery, and where auxiliary lighting batteries are used much cost and weight are saved by installing tungstens.

The numerous advantages of electric lamps in automobiles, including cleanliness, safety, convenience in lighting, reliability, etc., have made the tungsten battery lamps, which can replace oil lights without an excessive battery equipment,

NOVELTY TYPE, STYLE G-3½, ONE-HALF TO ONE AND ONE-HALF CANDLE-POWER, ONE AND ONE-HALF TO THREE AND ONE-HALF VOLTS.

very attractive to automobile users. Adapters have been devised for changing oil burners into electric fixtures, and a simple wiring scheme completes the outfit.

Novelty lamps for dry-battery service are made with the tungsten filament for a great variety of purposes, and can be



FORTY CANDLE-POWER, 6.6-AMPERE, TUNGSTEN SERIES LAMP.

used in flashlights, pocket-lamps, portables, night-lamps, and a variety of specialties manufactured by the trade.

The accompanying illustrations show samples of some different types of tungsten miniature and battery lamps. They can be obtained in round and pear-shaped bulbs and in special shapes and candlepowers, and in a great variety of voltages, mounted on either miniature or candelabra bases.

While American-made miniature tungstens have been on the market but a few months, many new uses are being constantly found for them, the great reduction in battery capacity making them suitable for purposes for which electric lamps were formerly impracticable.

TUNGSTEN STREET SERIES LAMPS.

Little has been written regarding the tungsten lamp for street series circuits, and the following comparisons have been

GENERAL BATTERY LAMP, ROUND STYLE, ONE TO FOUR CANDLE-POWER, FOUR TO SIX VOLTS.

GENERAL BATTERY LAMP, ROUND STYLE, FOUR TO TEN CANDLE-POWER, FOUR TO EIGHT VOLTS.

GENERAL BATTERY LAMP, STYLE P-8, FOUR TO TEN CANDLE-POWER, FOUR TO EIGHT VOLTS.

compiled to bring out the remarkable saving obtained by this new factor in the street-lighting field.

The value of the incandescent lamp in suburban districts is now generally conceded. The arc lamp has its place in densely populated districts (where the walls of the houses are close to the curb and by reflection eliminate dark shadows) and in locations where the required quantity of illumination warrants the units being placed near together.

In the less densely populated portions of our cities, however, the adoption of the arc lamp on an economical basis necessitates such great distances between the poles that evenly distributed and efficient illumination is impossible.

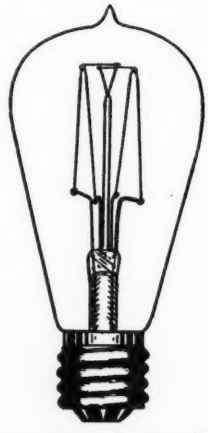
The tungsten series lamp is remarkable in many respects, and the success it has had from the first is a thing that has not often been duplicated in the electrical field. Long life results have been obtained, the average minimum being 1,200 hours, including all renewals, breakages, etc., and the average maximum over 2,000 hours, the general average being above 1,500 hours. These figures are not the result of a few installations, but of many thousand lamps.

Another remarkable quality of the lamp is that it maintains its candle-power practically constant, there being no blackening, which not only is a good feature while the lamp is burning, but gives it a much better appearance when the lamp is not lighted. This quality also allows the lamp to be used until it fails, and, together

TUNGSTEN BATTERY LAMP WITH STANDARD EDISON BASE, FOUR TO TWENTY VOLTS.

with its long life, reduces the labor cost of trimming to a minimum, a point which should not be lost sight of.

In comparing the tungsten series with carbon and Gem series lamps, there are two distinct advantages with the tungsten lamp, if actual costs alone are to be con-



SIXTY CANDLE-POWER, FOUR-AMPERE, TUNGSTEN SERIES LAMP.

sidered. The first is the saving in kilowatt-hours during a period of, say, a year's time, which is worth so many dollars according to the rate per kilowatt-hour for current. The other is the saving in capacity of station apparatus, or in other words, the station apparatus has a capacity

of three times the number of carbon lamps previously used. The former is a very large item where the generating costs, line losses, etc., are high, and the latter where the constant-current transformers are nearly fully loaded and it is desired to

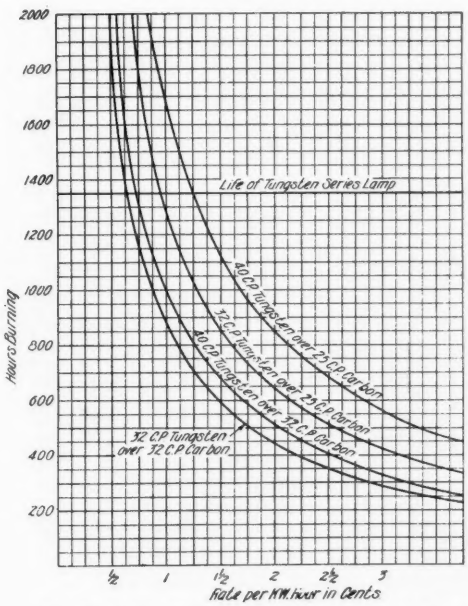


FIG. 3.—LIFE NECESSARY TO COMPENSATE FOR INCREASED FIRST COST OF TUNGSTEN OVER CARBON SERIES LAMPS, AT DIFFERENT RATES PER KILOWATT-HOUR.

put on extra lamps in excess of their capacity.

THE SAVING IN POWER.

Following are illustrations of the saving in kilowatt-hours of the tungsten over the carbon and Gem series lamps:

A thirty-two-candle-power carbon lamp consumes in watts.....	112
A thirty-two-candle-power tungsten lamp consuming forty watts gives a saving in watts of.....	72
For 4,000 hours' service per year this gives a kilowatt-hour saving of....	288
Value of saving at two cents per kilowatt-hour	$5.76
Net additional cost per year of tungsten renewals (three renewals tungsten, four renewals carbon).....	$1.85
Net saving per year for tungsten over carbon	$3.91
A thirty-two-candle-power Gem lamp consumes in watts.....	86.4
A thirty-two-candle-power tungsten lamp consuming forty watts gives a saving in watts of.....	46.4
For 4,000 hours' service per year this gives a kilowatt-hour saving of....	185.6
Value of saving at two cents per kilowatt-hour	$3.71
Net additional cost per year of tungsten renewals (three renewals tungsten, four renewals Gem).....	$1.62
Net saving per year for tungsten over Gem	$2.09

THE SAVING IN APPARATUS CAPACITY.

As an illustration of the value of the saving in apparatus capacity the following possible gain in income will serve as an example.

With apparatus capacity sufficient for 100 thirty-two-candle-power carbon lamps (3.5 watts per candle), a station could supply 280 thirty-two-candle-power tungsten lamps. Assuming $30 per lamp per year revenue, the possible gain in income from additional tungsten lamps would be as follows:

COMPARATIVE INCOME.

Income from investment in apparatus for 100 carbon lamps at $30	$3,000.00
Possible income from same investment in station apparatus for 280 tungsten lamps at $30..	8,400.00
Possible gain in income.....	$5,400.00

COMPARATIVE EXPENSE.

Tungsten lamp renewals at $1.27½, net, each, three per year for 280 lamps.....	$1,071.00
Fixed charges per year on additional line equipment for 180 additional lamps	150.00
	$1,221.00
Less expense of carbon renewals at 49.3 cents net, each, four per year for 100 lamps.....	197.20
Net additional expense.....	$1,023.80

NET GAINS FOR TUNGSTEN.

Hence net gain in income on each 100-light (carbon) capacity of apparatus is $5,400 less $1,023.80	$4,376.20
This gives a possible income per lamp station capacity now earning but $30 per year of.....	73.76
Or possible income per kilowatt-hour after the extra cost of tungsten renewals has been deducted ($73.76 ÷ 112 watts × 4,000 hours).....	16.4
The present income per kilowatt-hour with carbon lamps is—$30 ÷ 112 watts × 4,000 hours.	6.7
The income per kilowatt-hour, if an equal number of forty-candle-power tungsten lamps are used in place of thirty-two-candle-power carbon lamps, after the extra cost of tungsten renewals has been deducted is— $\frac{\$30.00 - (3 \times 1.27\frac{1}{2} - 1.97)}{50 \text{ watts} \times 4,000 \text{ hours}} =$	14

Fig. 3 and Fig. 4 show the number of hours at various rates per kilowatt-hour a tungsten series lamp must burn to exactly pay its increased cost. Should the lamp last any longer than this, there is an actual net saving during every moment of its use.

There is no doubt that the tungsten lamp enables central stations to compete with the gas and gasolene mantle lamps at very profitable rates per kilowatt-hour,

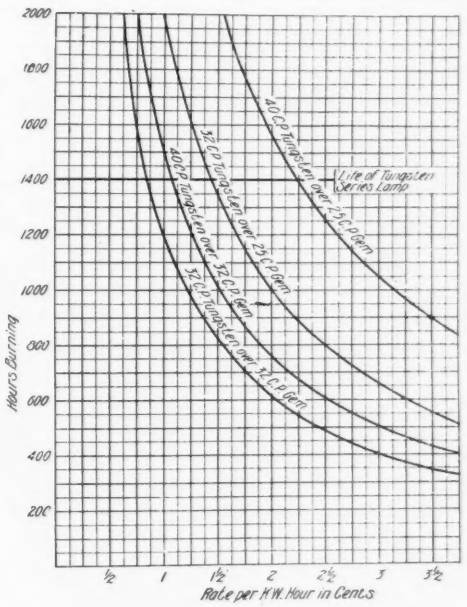


FIG. 4.—LIFE NECESSARY TO COMPENSATE FOR INCREASED FIRST COST OF TUNGSTEN OVER GEM SERIES LAMPS, AT DIFFERENT RATES PER KILOWATT-HOUR.

a thing that heretofore had been impossible. Twenty-five-candle-power carbon lamps have been used, but this has not satisfactorily met the situation. At rates of from $20 to $35 per year for 4,000 hours' (all night, every night) service for gas-mantle lamps, only a very low rate per kilowatt-hour is obtainable with carbon lamps to meet this cost.

Although the mantle is rated at sixty candle-power, tests recently made in three New England cities on the gas-mantle street lamp while operating under actual service conditions show, as the following figures indicate, a wide variation in candle-power:

	City.	Maximum C.P.	Minimum C.P.	Average C.P.
(1)	.....	55.0	21.5	36.7
(2)	.....	25.0	6.5	16.8
(3)	.....	55.1	16.3	27.8

RATES OBTAINABLE WITH FORTY AND SIXTY CANDLE-POWER LAMPS.

Income per year.....	$20	$22	$24	$26	$28	$30	$32	$34	$36
Rate per kilowatt-hour with forty-candle-power tungsten series lamps	8.8c.	9.8c.	10.8c.	11.8c.	12.8c.	13.8c.	14.8c.	15.8c.	16.8c.
Rate per kilowatt-hour with sixty-candle-power tungsten series lamps	5.4c.	6.0c.	6.7c.	7.7c.	8.0c.	8.7c.	9.4c.	10.0c.	10.7c.

Hence a forty-candle-power tungsten lamp which maintains candle-power practically constant throughout life will give better average illumination than the mantle lamps in any of the above cases.

The accompanying table shows the rates

that can be obtained with forty and sixty-candle-power tungsten lamps covering power and labor, the cost of tungsten renewals (three per year) having been deducted.

Very few cities supply a mantle lamp for less than $25 per annum, and, as the above table indicates, both the forty and sixty-candle-power tungsten lamps can easily compete with it profitably.

Another way of illustrating the above will be found in the following figures showing the cost of supplying a mantle lamp and the income for current obtainable to exactly meet it.

Consumption of gas per hour of mantle lamp	3½ cu. ft.
Cost of gas at $1 per thousand for 4,000 hours' service per year	$14.00
Renewals, repairs and labor at three cents per night per year (figures given in a recent city contract)	10.95
Total cost per year gas mantle.	$24.95

The possible rate per kilowatt-hour obtainable with the forty-candle-power tungsten series lamp to exactly meet the above cost is as follows:

Income per year per forty-candle-power tungsten lamp	$24.95
Three renewals at $1.27½ per lamp per year	3.83
Income per lamp per year to cover cost of power, labor and repairs	$21.12
A forty-candle-power tungsten lamp consumes in watts	50
For 4,000 hours' yearly service it consumes in kilowatt-hours	200
Hence rate obtainable per kilowatt-hour for power, labor and repairs is $21.12 ÷ 200, or over.	10.5 cents
Similarly the rate per kilowatt-hour obtainable for the sixty-candle-power (seventy-five-watt) tungsten series lamp, to cover cost of power, labor and repairs is $21.12 ÷ 300, or over	7 cents

The curves in Fig. 5 show the above graphically at various rates for gas.

The cost of producing a candle-hour of light with the tungsten series lamp is considerably less than the carbon lamp, as is shown relatively in Fig. 6. These values are determined on the differential basis

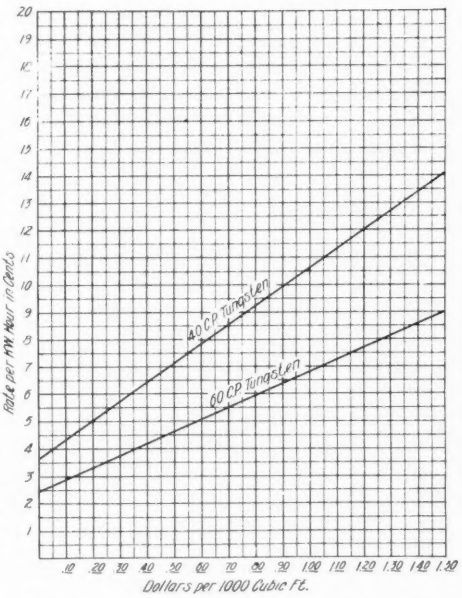


FIG. 5.—THE RATE PER KILOWATT-HOUR OBTAINABLE FOR FORTY AND SIXTY-CANDLE-POWER TUNGSTEN SERIES LAMPS TO MEET THE COST OF THE WELSBACH MANTLE AT VARIOUS RATES FOR GAS FOR 4,000 HOURS' YEARLY SERVICE.

for various hours' use of lamp per year, and cover:

First—Generating cost proportional to output covering fuel and station labor costs at a value (at the lamp) of one cent per kilowatt-hour.

Second—Fixed charge on investment in generating apparatus taken at twelve per cent on $125 investment per kilowatt of capacity, giving a value per kilowatt of apparatus of $15 per year.

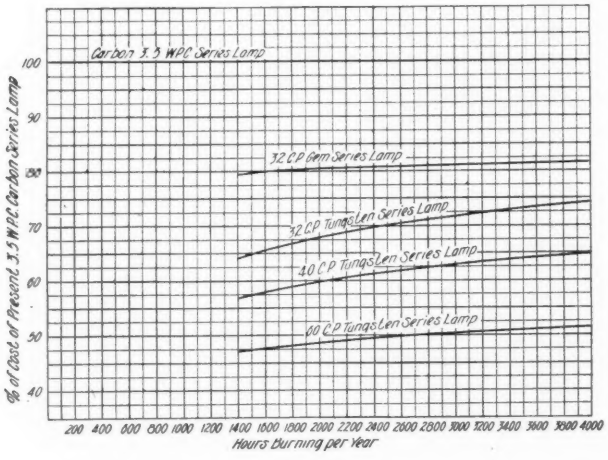

Carbon 3.5 WPC Series Lamp
32 CP Gem Series Lamp
32 CP Tungsten Series Lamp
40 CP Tungsten Series Lamp
60 CP Tungsten Series Lamp
% of Cost of Present 3.5 W.P.C. Carbon Series Lamp
Hours Burning per Year

FIG. 6.—RELATIVE COST OF PRODUCING A CANDLE-HOUR OF LIGHT—TUNGSTEN VERSUS GEM AND CARBON SERIES LAMPS.

Third—Renewal costs of lamps as estimated from the following prices:

Carbon lamp	$0.54
Gem lamp	.65
Thirty-two-candle-power tungsten lamp	1.50
Forty-candle-power tungsten lamp	1.50
Sixty-candle-power tungsten lamp	1.50

The candle-power and efficiency curves of the tungsten lamp during 2,000 hours' burning shows that there is very little depreciation in candle-power, and the efficiency in watts per candle remains very nearly constant throughout life. The lamps show practically no blackening at the end of the test.

The tungsten lamp also enables central stations to put incandescent lamps satisfactorily on existing series arc circuits, so that separate circuits and transformers are not necessary. With the carbon lamp this has not been entirely feasible, so that the tungsten lamp should be an aid in getting suburban street lighting contracts which heretofore may not have been possible.

CONCLUSION.

The tungsten lamp is unique in its combination of advantages—the great improvement in efficiency it secures being followed by gains instead of losses in other desirable characteristics.

The increase in efficiency is accompanied by lengthened life with a better maintenance of candle-power than in carbon lamps. The quality of the light, furthermore, is more brilliant, and instead of showing objectionable peculiarities is unsurpassed in its resemblance to sunlight.

The high efficiency of tungsten lamps does not make them susceptible to slight changes in voltage, but, on the contrary, the positive temperature coefficients of metallic filaments render them less liable to the effects of poorly regulated circuits.

With such a list of good points added to its remarkable economy, there can be no doubt that the tungsten lamp is here to stay.

Its improvement in quality in one year of American activity has been so great that predictions of future improvements, however enthusiastic, could hardly be called exaggerations, and remembering the early days of the carbon lamp the present characteristics of the tungsten seem remarkably free from faults.

Electric Traction in the Bernese Alps.

An appropriation of $200,000 has been made by the Bernese Alps Railway Company for the installation of electric traction between Spiez and Frutigen, on the northern approach to the Loetschberg tunnel. It is intended to use fifteen-cycle single-phase current at 15,000 volts line pressure. The current will be obtained from the Kander & Hagneck hydraulic plant at Spiez. The maximum gradient in the tunnel is 2.7 per cent.

Cooper Hewitt Lamp Progress.

SINCE its introduction into the field of illumination, the Cooper Hewitt mercury vapor lamp has undergone continual development, and, year to year, there have been evolved new types which have been the natural evolution of close application and keen scientific investigation in the effort to supplement the original high efficiency with ease of manipulation and invariability of service. The theory of operation and the characteristics of the mercury vapor lamp are well understood, and the present article will deal specifically with the mechanical construction of the lamps which are available to-day for commercial service.

FIG. 1.—COOPER HEWITT TYPE "H" AUTOMATIC-TILTING MERCURY VAPOR LAMP.

One of the improvements with which the lamp is at present equipped is a self-contained adjuster, which affords an economical and uniform current regulation, placed in an easily accessible position in the cylindrical casing which forms an integral part of the lamp fixture.

To avoid the method of tilting the lamps by hand to start the arc, which is quite practicable where the lamps can be easily reached, but is hardly feasible when the lamps are placed in inaccessible positions, an automatically tilting lamp, type H, has been produced. This lamp is illustrated in Fig. 1. When the line switch is closed an electromagnet is energized and a movable iron plunger tilts the lamp. When the arc is established the solenoid is automatically cut out.

This method is adaptable particularly where short lamps are used, and is supplemented for universal service by an automatic shifter starting method. The shifter is so-called because it shifts the current from its own circuit to that of the lamp. This starting method, briefly, consists in the introduction of the arc through the medium of a high-potential kick. This method of starting has been developed to such a point that the starting of the arc and the satisfactory operation of the lamp are invariable.

Three new types of lamps, all equipped with the starting method just indicated, are designated as type P, type U and type F. The type P lamp is shown in Fig. 2. This lamp is designed to operate on 100 to 120-volt circuits, and has a mean hemispherical intensity of 800 candle-power on 110 volts, the current consumption being three and one-half amperes.

The type U lamp, shown in Fig. 3, is calculated for the double voltage of the type P lamp. The construction of this lamp is similar to that of type P, with the exception of the difference in the physical form of the U-shaped vacuum tube. The lamp consumes two amperes on 220 volts, and has a luminous intensity of 900 mean hemispherical candle-power.

Upon the principle of the mercury rectifier, the mercury vapor lamp is adaptable to use with alternating currents. Any difficulty which was experienced with the alternating-current mercury vapor lamp, due to trouble in starting, has been overcome by the use of the new shifter method. The alternating-current lamp, the type F, (Fig. 4) is similar in appearance and construction to the type P lamp, but, like a rectifier, has two positive (iron) electrodes connected to a transformer, the middle point of which leads over an adjuster and two inductance coils to the negative (mercury) electrode. The inductance serves in this case both for the starting of the lamp and the damping of the current pulsations on the negative running arc. The auxiliary apparatus is similar to that used with the type P lamp, but a transformer is added, and this is generally made an integral part of the outfit, but in exceptional cases can be supplied as a separate installation. This lamp is

FIG. 2.—COOPER HEWITT TYPE "P" MERCURY VAPOR LAMP.

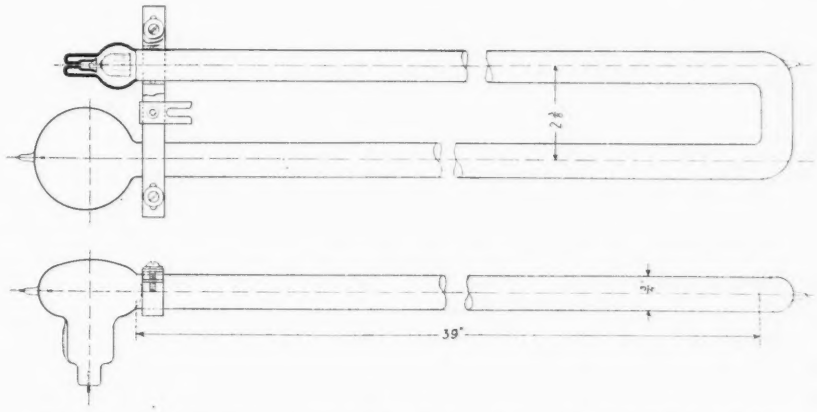


FIG. 3.—REPRESENTATION OF TYPE "U" COOPER HEWITT MERCURY VAPOR LAMP.

designed in six types, for various voltages, and consumes, on the mean voltage for each respective type, 400 watts with a mean hemispherical illumination intensity of 800 candle-power and a primary power-factor of eighty-three per cent.

A summary of the present installations of the Cooper Hewitt mercury vapor lamp indicates that it is being used successfully for the illumination of almost every conceivable character of interior industrial illumination. It has been found particularly adaptable to the illumination of large areas where a high quality of lighting is necessary for the carrying on of processes requiring close inspection. One of the most recent successful invasions of this lamp is in silk-mill illumination. As far as the process of making silk is concerned, it is not so much a question in the mill of matching colors as it is of securing a uniform product and detecting at once any variation in the physical character of the silk threads. The testimony of silk makers who have used this form of illumination is to the effect that the peculiar quality of the mercury vapor lamp renders it very easy to detect any flaws which may develop in the textile during the process of manufacture.

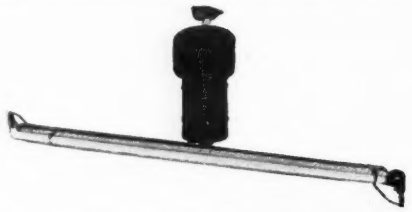


FIG. 4.—COOPER HEWITT TYPE "F" MERCURY VAPOR LAMP.

Electricity Supply in Marseilles, France — The Brillanne-Villaneuve Hydroelectric Station.

The Brillanne-Villaneuve hydroelectric station, which partly supplies Marseilles with electrical energy, is described by J. A. Montpellier in *L'Electricien* (Paris), August 22, for the benefit of electricians who will visit that city during the coming International Congress of Applied Electricity. The station is situated near the community of Brillanne, on the banks of the River Durance, from which water is taken at the rate of sixty cubic metres per second to a head reservoir through a canal starting eight kilometres above the station. From the head reservoir the water flows into five large sheet-steel pipes, eighty metres long and 2.70 metres in diameter, each one of which feeds one of the groups of generators. A sixth pipe, 1.2 metres in diameter, feeds the turbine driving the exciters. The turbines are of the two-wheel Francis type, each installed in a separate water chamber, but all having one common discharge channel. They can generate 3,500 effective horse-power each under a head of twenty-two metres at an angular velocity of 250 revolutions per minute. Each turbine is directly coupled to an alternator. The exciters are driven by Francis turbines of 250 horse-power. The station is to contain five generator units, of which four are at present in operation. The dynamos are three-phase alternators of 3,000 kilowatts, furnishing a current of 7,500 volts and twenty-five periods a second. The exciter is a 200-kilowatt, direct-current machine giving 110 to 125 volts. On account of the high tension adopted on the transmission line, 52,000 volts at the station, the transformers are installed in a separate building, which occupies a space of 1,100 square metres, while the generating station occupies 1,000 square metres. Each alternator is connected by a paper insulated, lead-covered cable with three conductors to a group of three single-phase transformers, of a capacity of 900 kilowatts each and a ratio of transformation of one to four. By a triangle connection in the primary circuit and a star connection in the secondary they raise the tension between phases from 7,500 to 52,000 volts. The transformers had to be constructed with particular care and required special precautions for cooling. Their windings are immersed in oil and the oil is cooled by the circulation of cold water through a coiled pipe. Automatic devices indicate any abnormal rise of temperature in the oil at the station. The current from each group of transformers can be led to either one of two series of bus-bars, from which the 52,000-volt, three-phase transmission lines branch off and leave the building from special bays in which Wirt lightning arresters are installed. All the high-tension circuits are controlled by special three-pole circuit-breakers, which are operated by small direct-current motors by means of cogs and levers, a double break taking place in oil and each phase being in a separate brick compartment. A 10,000-kilowatt current at 52,000 volts can be thus interrupted without deteriorating the contacts. The small motors operating the circuit-breakers can be controlled at will from the switchboard, and the circuit-breakers also open automatically when the current rises to a dangerous intensity. All the controlling, regulating and measuring instruments are placed on the main switchboard of the station. The safety of the attendants is insured by the fact that all of these apparatus, without exception, operate under 110 to 125 volts, direct current being used for the motors actuating the circuit-breakers, and the alternating current being reduced by tension and intensity transformers. Three high-tension transmission lines leave the station, going, respectively, to Allauch, Arles and Marseilles. The line supplying Marseilles is over 100 kilometres long and the tension of 52,000 volts is the highest so far adopted in Europe. The plant has been in operation for over four months, so far without incident. All the machinery and apparatus have been supplied by the French Thomson-Houston Company.

The Empire State Gas and Electric Association.

The annual meeting of the Empire State Gas and Electric Association will be held in the Engineering Societies Building, New York city, on October 7. Among the subjects to be discussed are the following: "Public Policy Work of the Association;" "Standards for Gas Service and Standards for Electric Service, Taking as a Basis the Recent Rules of the Railroad Commission of Wisconsin;" "Taxation of Gas and Electric Companies in New York State, with a Report from the Taxation Committee;" "Insurance of Gas and Electric Stations;" "Review of the Decisions of the Public Service Commissions;" "Electric Meter Testing, with Report from the Meter Committee;" "Accounting, with Report from the Accounting Committee;" amendments to the constitution and by-laws, with a new schedule of annual dues; affiliation with the American Gas Institute and the National Electric Light Association.

The secretary of the association is Charles H. B. Chapin, 154 Nassau street, New York city.

The New Westinghouse Nernst Lamp.

By Otto Foell.

IN the 1907 "Electric Lighting and Illuminating Engineering Number" I presented to the readers of the ELECTRICAL REVIEW the commercial status of the Nernst lamp. In the interim we have witnessed great activity on the part of lamp manufacturers to improve the efficiency of the incandescent units.

The Nernst lamp has kept pace with the demand for increase in economy. Great progress has been made during the past year in the application of the Nernst glower principle, and to-day I am prepared to outline some new features of Nernst lamp practice which, with the mechanical improvements embodied in the designs,

FIG. 1.—MULTIPLE-GLOWER WESTINGHOUSE NERNST FIXTURE LAMP WITH SQUARE CANOPY AND CHAIN.

make the new Westinghouse Nernst lamps the most efficient and economical lighting system, as by their use the total cost of light (current plus upkeep) is reduced to the lowest point ever reached by incandescent lighting units.

The principle of the Nernst lamp is well understood by this time.

The incandescent body or glower is a non-conductor for electricity when cold but becomes a good conductor when heated and remains a current conductor by reason of the energy dissipated in the filament.

The lamp body contains the parts for starting the glower and for current control, the former being an electric heater with automatic cutout, the latter a small iron wire resistance mounted in a glass container, exhausted and then filled with an inert gas.

When first introduced, four standard sizes of lamps were manufactured for operation on alternating current: a six-glower lamp, a three-glower lamp, a two-glower lamp and a single-glower lamp, varying in mean lower hemispherical efficiency from 1.64 watts per candle-power to 2.54 watts per candle-power, this efficiency data based on lamps equipped with alabaster or diffusing glassware.

A little later the four-glower lamps were brought out to meet a want for a unit between the three and six-glower sizes.

The bunching of glowers in parallel on one burner or holder created an incandescent unit which gave the lamp a wide field of usefulness.

About a year ago the 110-watt Nernst was introduced. This unit marked one great step toward realizing a higher glower efficiency. Its general success led to the present perfection of a complete line of lamps.

Coincident with the marketing of the 110-watt unit, the advent of the direct-current Nernst lamp was announced. These direct-current units are now used in large numbers and among the prominent installations I desire to mention the great store of Marshall Field & Company, in Chicago, where 12,000 units are employed.

It should be remembered that the glower, being a conductor with negative temperature coefficient, requires for current control a highly sensitive ballast resistance, and upon the ability of this resistance to perform its function properly depends to some extent the glower life performance.

Users of the standard Nernst lamp are probably aware of the fact that immediately upon lighting the amount of light emitted is far in excess of the rated candle-power of the lamp. This is caused by an excess current flowing through the glower, the current gradually decreasing until the lamp attains normal operating temperature.

In the new Westinghouse Nernst lamp a great improvement in electrical performance has been attained. That is, the individual life performance of the glower has been improved, ballast troubles have been reduced and the heater has been made of such proportions and such lasting qualities that a lamp once installed will need very little attention. The combination of these properties naturally results in a lower maintenance cost.

The features just mentioned, even without improved efficiency, would make the Nernst lamp a very attractive commercial lighting proposition. We, however, did not stop in merely improving the electrical performance and reducing the maintenance cost, but succeeded in materially increasing the efficiency of the lamps. Hand in hand with these improvements there was an improvement in the mechanical arrangement of the different lamp parts, so that the Westinghouse Nernst lamp of to-day represents a unit of high efficiency,

FIG. 2.—MULTIPLE-GLOWER WESTINGHOUSE NERNST FIXTURE LAMP WITH ROUND CANOPY.

good electrical performance and low maintenance cost.

Before I go into a detailed description of the different Westinghouse Nernst units available for commercial use, I shall deal generally with the principles of current control in the lamp and their influence on the performance of the glower.

Since the current through a glower is controlled by the ballast, it naturally follows that improvements in glower performance must begin in a better ballast performance. This may be accomplished by placing the ballast in a medium where its characteristic is not influenced by its surroundings.

In the standard Nernst lamps the ballasts are bunched. Their heat is emitted and radiated into an enclosed housing,

tending to decrease the current capacity of the ballast. To offset this effect the ballast was designed to take a current, when cold, far in excess of its normal operating current. Moreover, the question of supporting the resistance wire was not very well understood and material was used in the construction of the ballast which tended to further decrease its current-carrying capacity.

In the Westinghouse Nernst lamps now available, this objectionable characteristic has been eliminated by so increasing the radiating surface of the ballast that the ballast characteristic is not influenced by its surroundings. The mechanical device consists of a number of phosphor-bronze pieces placed in a cooling cylinder and so formed that the contact surfaces firmly enclose the ballast. The heat liberated in the ballast is transmitted to the bronze pieces by contact, and from there it is radiated and conducted into the surrounding air.

The effect of this improvement in glower current control is readily noted immediately after lighting the Westinghouse Nernst units.

Hand in hand with improved current control came the improvement of the glower proper.

The glower of to-day is a radical departure from the glower used in the older lamps, both mechanically and in the composition of its constituent parts. Mechanically we have to-day a greatly improved terminal construction which reduces the terminal loss due to the Peltier effect approximately two-thirds. The result is a longer lighting length between terminals for a specific voltage. Moreover, a larger percentage of radioactive material is used in the glower, the properties of which have been recently established. Their addition to the glower mixture greatly increased the glower efficiency without materially increasing its operating temperature.

The characteristics of the new glower are about the same as those of the old glower, with the exception that its candle-power performance during life is more constant, which means Nernst lamps with only slight candle-power depreciation.

However, one feature not to be overlooked is the individual life performance of the new glower. Owing to their treatment during manufacture, glowers of old construction were more or less unreliable. While the average life performance of the glowers was all that was claimed for them, yet there were early failures. The new terminal successfully overcame this defect in the glower and failures during early life should be few and far between.

The ballast employed in the Westinghouse Nernst lamp is of rugged design. The iron resistance wire is enclosed in a bulb of increased diameter, so that an anchoring of the resistance wire other than on the terminals is unnecessary. These anchors, being metallic supports, have little heat capacity compared with the former porcelain disc anchor, and consequently give the ballast very quick action; that is, voltage variations of the circuits are immediately taken care of, thereby protecting the glower in the most sensitive way against possible overloads. On the other hand, the ballast itself is very well adapted to withstand voltage fluctuations without damaging it, a noteworthy and desirable feature.

FIG. 3.—SCREW BURNER FOR WESTINGHOUSE NERNST LAMP.

A mechanical detail to which I desire to call attention is that all ballasts are equipped with a bayonet socket, making their replacement an easy matter.

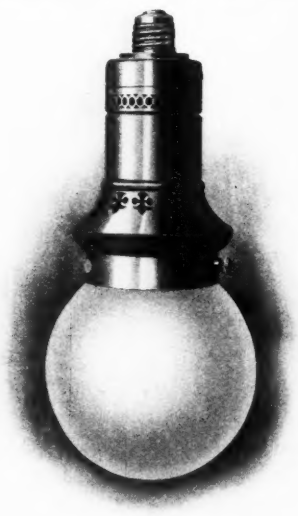


FIG. 4.—SINGLE-BURNER WESTINGHOUSE NERNST LAMP.

DESCRIPTION OF LAMPS.

The mechanical construction of the multiple-glower lamp presents a harmonious design, embodying simplicity and compactness. Unsightly exposed terminals are done away with and in their stead the insulating hook is provided with an opening through which the service wires enter the top of the lamp housing and terminate in two enclosed binding posts.

This construction makes it possible to use the lamp in connection with fixture work by substituting a special fixture nipple for the standard insulating hook. Fixture lamps are illustrated in Figs. 1 and 2.

Extending from the terminal construction is a tubing to which, by means of screws and washers, is fastened the middle part of the housing, containing the ballast coolers. Sliding up and down inside the tubing is a brass rod serving to support the lower part of the lamp body, including the ballast plate, contact plate for holder and globe-holder ring.

The sliding inner post is provided with a steel stop engaging in a slit of the tubing, serving to lock the two parts of the housing together by means of a hooking catch, which may be operated by the lever provided in the middle part of the housing.

This construction affords an easy access to the ballasts, as the latter are arranged to drop with the lamp body when it is lowered.

The cutouts are below the ballast porcelain and electrical connection between the terminals, and the ballast plate is made by means of a brass rod and brass tubing, the latter sliding up and down with the lower part of the lamp, insuring electrical connection at all times.

The alternating-current Westinghouse Nernst lamps are provided with two cutouts, one located in each side of the service line. The direct-current, multiple-glower Westinghouse Nernst lamps have one cutout only, opening the heater circuit at the positive side of the supply circuit.

The part of the lamp body containing electrical connections is fastened to the lower lamp housing by means of an accessible nut. This housing is arranged in such a way that it leaves insulated openings for the insertion of the holder.

The petticoat of the lamps, which serves at the same time as a globe-holding device, is composed of two main parts, an inside and an outside shell, which are of different diameters and arranged like two concentric rings, one inside the other, thus providing an opening for ventilation. The air for ventilating is drawn into the inside of the lamp housing through this opening and through the ornamental openings in the petticoat and leaves the lamp,

after passing through the ballast coolers, through the outlets provided in the top part of the lamp housing.

The device for holding the globe to the lamp housing is similar in construction to the globe holder used in the arc lamp. It consists of a phosphor-bronze band which is fastened to the globe by means of screws. From this band two lips protrude which engage with properly shaped wire rings on the lamp body. The latter are pivoted eccentrically in movable stampings, which when moved simultaneously toward the lamp housing draw up the globe and hold it firmly in place. When lowering the globe, one lip of the globe band is easily disengaged, the globe swings freely on the other, thus giving ready access to the holder and facilitating rapid maintenance.

The holder of the Westinghouse multiple-glower units presents a radical change in design. The old two-piece porcelain holder is replaced by a one-piece holder base, to which are attached contact prongs as shown in Fig. 7. Two prongs are brought through the holder base and are secured in such a manner that they lie in a plane parallel to the glowers and at right angles to them. The use of two or more heater tubes is superseded by a wafer heater, a heater consisting of a small platinum-wound rod, which in turn is coated with refractory cement and bent into the form of a wafer, from which the heater obtains its name. The wafer is mounted securely to a flat porcelain. This porcelain is provided with contact sleeves,

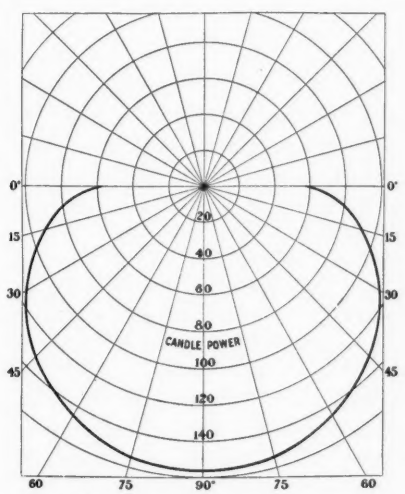


FIG. 6.—DISTRIBUTION CURVE OF 132-WATT TYPE WESTINGHOUSE NERNST LAMP.

which engage with the heater prongs on the holder, holding it firmly by friction and at the same time making electrical connection. This design simplifies maintenance to a great extent as it allows the removal of the heater without disturbing the glowers, a feature which was not possible with the old-type holders. It is evident that such a holder means decreased

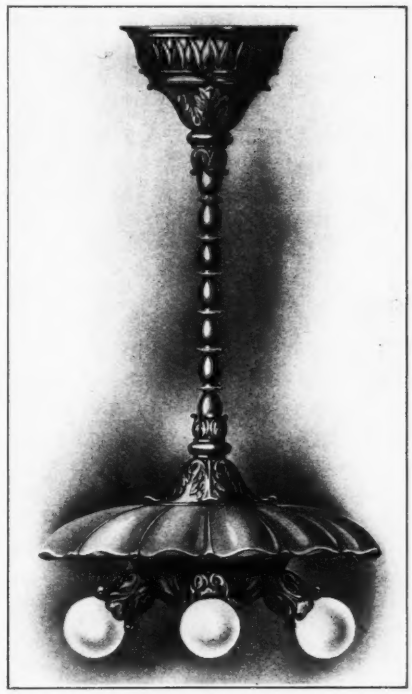


FIG. 5.—FIXTURE FOR SINGLE-GLOWER WESTINGHOUSE NERNST LAMP.

cost of maintenance, a saving being made in both labor and material.

The various sizes of single-glower lamps are of the Edison base type, very similar in construction to the new popular 110-watt unit, but present a radical change in the method of maintenance, which is simple in the extreme.

In the bottom of the lamp housing is found a screw receptacle in place of the prongs formerly used in connection with the "push-type" holder.

The present holder consists of a glower and wafer mounted on a small porcelain with a screw base and provided with three contacts, the centre one of which is a pin. This renewal is popularly termed the "screw burner." See Fig. 3.

By an assortment of diameters and lengths of the contact pin, it is impossible to insert any other than the proper holder in the lamp body, thereby insuring the consumer against troubles incident to confusion from lamps of various voltages and current capacities.

The holder can be supplied with or without glassware of various sizes and density. This type of renewal will supply the popular demand for a high-efficiency incandescent lamp so rugged in its design that systems can be maintained by any one, and the renewals safely shipped by freight, mail or express. Fig. 4 shows the general appearance of the lamp.

The value of any lighting system does not depend, however, on its efficiency alone, but due consideration must be given to the cost of its maintenance. All other factors, such as life, being equal, a system having an efficiency for the same candle-power delivered may be preferable on account of its low maintenance cost, which may be so low that the increased cost of current consumed is more than offset by its lower maintenance cost.

The new Westinghouse Nernst lamp, which combines the highest efficiency (and with a daylight quality of light) with lowest maintenance, I believe, has no equal to-day in artificial lighting.

EFFICIENCY AND MAINTENANCE.

The efficiency of any lighting system is best expressed by the horizontal intensity of illumination produced by its light sources when suspended at a specified height above the test plane. That is, only light sent out by a lamp in a downward direction or its mean lower hemispherical candle-power can be considered. Therefore all figures for efficiency given below express the economy of the Westinghouse Nernst lamps in watts per mean hemispherical candle-power.

All holders for the new Westinghouse Nernst unit are designed along the same principles as have been consistently advocated by the Nernst Lamp Company since the advent of the Nernst lamp, namely, to give a downward distribution, with as

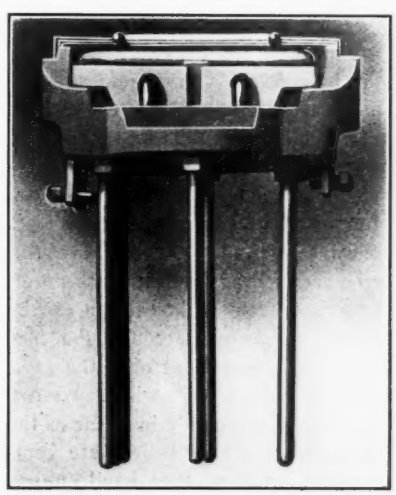


FIG. 7.—WESTINGHOUSE NERNST MULTIPLE-GLOWER WAFER HEATER HOLDER.

little light in the upper hemisphere as possible.

Consequently the glowers are arranged horizontally below the heater, thereby throwing almost the entire flux of light

downward from the glower in the useful plane.

Fig. 6 gives the light distribution from a 132-watt direct-current type Westinghouse Nernst lamp equipped with clear glassware. This curve represents the average result of a number of holders and should be considered typical for this unit. The mean lower hemispherical candle-power is equal to 114.8 the corresponding efficiency being 1.2 watts per candle-power.

In comparing these figures with the data published for the old type two-glower lamp, it will be noted that the efficiency is increased from 2.05 watts per candle-power to 1.2 per candle-power, or a gain in light of forty-one and one-half per cent for equal energy consumed.

The efficiency per mean lower hemispherical candle-power of this unit is 1.07 watts, which is equal to 516 mean lower hemispherical candle-power. It will be noted that this unit is not only the largest incandescent unit on the market, but in every respect it delivers the most light for the energy consumed.

The distribution is ideal, especially for large interiors with high ceilings. A five-glower, 660-watt Nernst unit will also be placed on the market this year, having a still greater efficiency.

The figures for efficiency are somewhat modified when lamps are used with diffusing glassware. The latter case is the rule rather than the exception. I have given the efficiency figures for clear glassware to show what is possible with the new Westinghouse Nernst units and to establish a basis of comparison with other incandescent lamps.

A series of tests has been made to determine the visible spectrum of the glower when the light is passing through different opalescent globes. The combined efforts of the glass manufacturers and the Nernst Lamp Company laboratory resulted in an alabaster globe being adopted as standard, which gives a well-diffused light with the least loss in efficiency.

The light absorption in the special Nernst globe is about fourteen per cent. The character of the distribution curves is not changed materially, that is, the light emitted from a Westinghouse Nernst unit is decreased in the different vertical angles about fourteen per cent when equipped with diffusing glass as compared with clear globes.

In conclusion I want to say that the invention of the Nernst glower stimulated activity in all directions and to-day we have a number of incandescent lamps, of various efficiencies. While all the latter lamps are vacuum lamps and depend on a good vacuum for life performance, the distinct advantage of the Nernst glower lies in the fact that it is operative in the open air. It can be readily understood that such a principle must be the basis of all future developments in high-efficiency lamps.

The screw burner principle makes it possible to obtain very artistic and desirable combinations, also permitting the operation of the burners in any position.

To meet the demand for artistic fixtures the Nernst Lamp Company has developed a line of Westinghouse Nernst fixtures, which are available for alternating current or direct current, 110 or 220 volts. Fig. 5 illustrates one of the standard fixtures now ready for the market. It may be used with sixty-six, eighty-eight, 110 or 132-watt units.

The Illuminating Engineer as an Architectural Critic.

By Bassett Jones, Jr.

"NOTIONS of some sort," says Symonds, "underlie all judgments." By notions he means the organization of personality peculiar to each individual. This organization of the personal self determines the form of the active judging attitude we take toward experience. No two minds will perceive objects in the same way, unless the stock of "funded" truths which each possesses is each for each alike. New ideas can never be accepted as true unless the present organized facts of knowledge can be readjusted to make place for the new thought. This fact is at once the safeguard and the danger of society. We can live together in peace only in so far as the presuppositions of our beliefs are common, while, on the other hand, unless there is some diversity of attitude there can be no development and no advancement.

There will be, then, certain basic common attitudes—the attitudes we adopt toward justice, liberty, and morality for instance—which will form the substratum of the basis upon which the larger groups of society are founded. Above these fundamentals society will be found to break up into smaller and smaller subgroups until the essentially personal attitude of the individual is reached. The active judging attitude of each group will determine the perspective in which reality is seen and will determine the aspects of reality that go to make up the world of knowledge common to the group. The validity of judgments is determined by whether or no the activity subsequent to and founded upon the judgment brings experience that fits into the world of knowledge, or the presuppositions which determine the judgment, and not upon whether or no this experience fits into some other scheme of knowledge foreign to the judgment. When such experience does fit, we say that the judgment is a true judgment. Truth is a meaning that attaches to the result of a valid judgment *per se*.

It then follows that attitudes can not be judged with relation to some form of funded knowledge that does not give rise to them, except and only in so far as the basis of the judgment is common to both attitudes, namely, the attitude judged and the attitude giving rise to the judgment.

Society is grouped, then, according to the attitudes toward experience common to the individuals forming the group. Thus scientists possess in common one attitude toward experience, engineers possess another, artists possess a third, mathematicians possess a fourth. Each deals largely with the same experience, yet each isolates and selects certain aspects of this common experience and judges it according to his own light. All these various aspects are equally real, and the judgments dealing with each aspect, in so far as they result in co-ordinated knowledge, are equally true. The engineer can not say of the artist that his judgments are bad, because their results do not "gee" with the engineer's presuppositions, nor can the scientist claim all truth as particularly his because the truths of other men's worlds are not the truths of his world.

I think that ignorance of or failure to realize the importance of these facts is

at the basis of much of the inadequate and mistaken criticisms that have been made both by architects and engineers, one of the other. In some cases there sems to be on both sides a failure to recognize the meaning and intent of activity. The architect "has it in" for the engineer, so to speak, because the engineer does not appreciate the importance of meeting the conditions that the design imposes, while, on the other hand, the engineer "cusses out" the architect for interfering with the working out of his pet formula for efficiency. The cause of this state of affairs is due largely to an unfortunate over-specialization in education. But the education of the architect is necessarily somewhat broader than that of the engineer and his "fund of knowledge" is usually of sufficient scope to enable him to understand the means whereby the engineer arrives at his conclusion, whereas to the engineer there is usually something so inexact and "unreal" about art that he is prone to assume offhand that the æsthetic qualities of the design are of relatively little utility; or if the engineer does possess any artistic appreciation of the value of beauty he often tries to formulate his æsthetic judgments in the same way that his professional judgments are developed. In other words, he tries to reduce the facts of the æsthetic world to a system of scientific truths. The result is quite as logical as an attempt to organize the facts of the scientific world by the method of the æsthetic judgment. Of course we do not mean by this that the development and meaning of art and the æsthetic consciousness can not be made the subjects of rigorous analysis. But there is every difference possible between describing the processes of art in definite laws, and evaluating the results of the operations of these laws. To attempt to define one in terms of the other is to violate a fundamental canon of logic.

The necessary broadness of the architect's training sometimes places him in a position where he can judge the relative importance of the various factors in the construction of a building, whereas often the engineer is only able to realize the importance of what he himself desires to do. This has resulted in a disposition on the part of the architect to criticize where sometimes his criticism is unjust. A further result of this situation is that the co-operation of the engineer has been forced upon the architect rather than that the assistance of the engineer has been accepted as an unquestioned necessity.

Any behavior on the part of the engineer that tends to widen rather than heal this breach is unfortunate, and I propose to devote the remainder of this paper to pointing out certain mistakes in criticism which have been made by those who stand as representing the profession of illuminating engineers.

The situation, as I see it, is this: The illuminating engineer is seeking the opportunity to apply scientific principles to artificial illumination. He claims, and his claim is doubtless just, that since the old empirical methods of heating, sanitation and structural design have been reduced to general wide principles applicable to all cases, the same methods should be employed in designing lighting arrangements. He must remember, however, that in almost every case the heating and the structural engineer do not attempt to dictate to the architect how his building should be designed in order that their apparatus may be as economical and as inexpensive as possible. On the contrary, these experts take the plans as they come and lay out their work to fit the building as designed, except in rare cases where the design is such that the conditions can not be met without exorbitant expense; in which case there is usually found some solution satisfactory to both parties. The heating expert does not demand that iron-pipe coils shall be used in every case simply because iron pipe is the most efficient radiating surface known, nor does he demand that radiators shall be located only thus and so, and that they shall never be concealed because concealing them hides their true nature and lowers their efficiency between twenty-five and thirty per cent. Furthermore, he agrees with the architect that radiators and registers are at the best unsightly and should be made as inconspicuous as is possible, or else their design should be such that they will, as far as posible, tone in with the environment and become in appearance at least a part of the architectural treatment.

The structural engineer does not insist that false steel work shall never be used solely for architectural effects, or purely for supporting decorations, nor does he attempt to criticize the architect for doing all he can to hide his essentially mechanical structure. Neither does he say to the architect that he, the architect, does not know his business because he does not make his design illustrate the method of construction. On the contrary he admits that such things form no part of his business, and if he thinks of it at all, he probably admits that the architect knows what he wants and knows how to obtain it. The illuminating engineer, on the other hand, has taken upon himself, officially at least, the duties of a general architectural critic. In which he may be justified if he feels that way, and considers himself fitted to undertake the task. It seems, however, that he would exhibit better judgment if he presented himself as a critic under the proper auspices. It is a little hard to expect a man to co-operate with you if you slap his face at every opportunity. Furthermore, it seems to be the duty of the critic to appreciate and evaluate the object of his criticism from the viewpoint of the social group to which the individual belongs who created it. It is as senseless to criticize a lighting fixture solely on the basis of its qualities as a light-giving source, as it would be to criticize a building solely as a means of furnishing shelter. The lighting fixture has to give light, it is true, and also it is primarily a *lighting* fixture; but that is not all it is by any means. From the designer's viewpoint it must possess his conception of beauty and he is often quite at a loss to find some way of giving even some semblance of beauty to the very mechanical requirements that the scientist has imposed upon him.

There seems to be a prevalent idea that true criticism is destructive and not constructive. This assumption, however, fails to properly account for the attitude from which the criticism is made. Criticism must be founded upon some basis of knowledge, and it seems impossible that criticism is not a matter of comparison between what is and the ideal construction of what ought to be. To know what is wrong it seems that the critic must, *ipso facto,* know what is right, and if one assumes the duty of critic he must be prepared either to present his reasons or to be completely misunderstood. Nor is criticism a mere cataloguing of faults, for the critic, *qua* critic, assumes a position which he thinks is higher and more thoroughgoing than the position of that which he criticizes. If he is an architectural critic he assumes that he knows more about the meaning and intent of architecture than the architect himself. But the knowledge on which his critical judgment is formed must be architectural knowledge, and not mere knowledge of the history and development of the forms of construction used in architecture. If he thinks that architecture is principally a matter of construction, then he is wofully in error. As a matter of fact, in

architecture the emphasis is always on the form rather than on its construction.

One may agree substantially with a theory of æsthetics based upon the development and meaning of the objective aspect of art. But when this theory is used as a basis for criticism of the solely subjective quality of beauty it is time to call a halt. No amount of study as to how things have come to be as they are can tell us altogether why we consider them beautiful or not. The *how* of things is probably far more dependent on the *why* than we are at first blush disposed to imagine.

The engineer is fully within his rights in criticizing objects from his viewpoint; but he should not criticize them for meeting some other requirements at the same time. He should appreciate the fact that the relative importance of requirements placed upon the object from viewpoints other than his may require and make necessary some modification of his own demands.

If the illuminating engineer criticized lighting fixtures only, and only as fulfilling or not fulfilling engineering requirements, the architect would have no complaint to make. But the engineer as engineer has been emphatic in his opinion as to the artistic value of many lighting installations, and, not satisfied with this, he has extended his criticisms to architectural treatment in general.

We find his printed opinion that certain works of some of our most famous architects are monstrosities, and others are in bad taste; that the modern architect is a mere copyist and compiler. We are told that the famous Hall of Mirrors in the Palace of Versailles is archaic in comparison with many a café along "The Great White Way"—that, since diamonds are always in good form (!) therefore, the faceted or prismatic glass pendent is equally beautiful and appropriate, no matter what particular period the furnishings or decorations may be in. Oh, shade of John Stuart Mill; Oh, memories of Canterbury! We hear that fixture designers often make the mistake of considering themselves artists, and that since the lamps and their accessories weigh be a few pounds, it is senseless to support them by a structure that in itself weighs many times more.

I do not mean to say that there may not be very good reasons for these, and many similar statements, for the percentage of men engaged in the architectural profession who are little fitted to cope with their responsibilities is probably not very different from the relative number of engineers in a similar position.

Concluding these remarks, is it any wonder that instead of accepting the illuminating engineer at his real worth, the architect says that he does not know what he is talking about? The attitude that the illuminating engineer seems to have taken has undoubtedly retarded the development of the profession and it will continue to do so for some time to come.

The Position of Electric Lighting in England.

By Albert H. Bridge.

PERHAPS at no previous period of the electric lighting industry have engineers been in the midst of such changes and uncertainties as they are at the present time, yet notwithstanding this circumstance there is a very decided ring of optimism in the remarks of those who attempt to foretell the future.

It has been recognized that gas engineers have already passed through experiences very similar to those of the electric lighting engineer and manager to-day—indeed, are still so passing. A very striking speech to this effect was delivered only a few days ago at the meeting of perhaps the largest gas supply authorities in England, and because the writer believes it to be of interest to electrical readers he quotes it below. It will be observed that with only a very slight variation in one or two particulars it represents the position of electrical lighting as accurately as it does that of gas illumination:

"The diminished sale was fully accounted for by climatic conditions, while the substitution of new lamps for old, of methods of burning which were increasingly economical from year to year, had added to the volume of light while enormously reducing the quantity of gas needed to produce it. One comparatively small railway station had reduced its consumption in this way by 3,000,000 cubic feet, and a city warehouse by very nearly the same amount, and these were only types of thousands throughout the company's district. They welcomed every improvement in this direction, but the immediate effect was to curtail the company's business. The simple inverted incandescent burners gave a light eight times better than good flat-flame burners, or in other words the same light could now be obtained from 1,000 cubic feet which would have required 8,000 a few years ago. With gas used at high pressure the increase was not eight times, but twenty times."

One of our illuminating experts, Leon Gaster, has gone so far as to suggest the idea that the severity of the competition between gas and electricity might be eased, or put an end to altogether, by the adoption of some mutual limitation of spheres of work. There is something Utopian in the idea; no one can say that any prospect of such an arrangement has appeared on the horizon, and few things seem to the writer less within the realm of probability. In the midst of metal filament-lamp prophesies and hopes, however, it were unwise to attempt to indicate what the effects of the most recent electrical advance may be even upon gas authorities in the course of a few years. British gas interests have developed a fighting spirit of enterprise which they did not possess in presence of a weaker rival and electrical interests are gradually becoming more enterprising too, but their desire is to hold the hand until they see which way the metal-filament cat jumps in their stations.

At St. Pancras the electricity department recently stated that the one thing that stood in the way of the small consumer was the cost of wiring and fitting. Some students of the situation urge the sanctioning of cheaper and more simplified wiring systems, a greater freedom from onerous restrictions, and some even go so far as to advocate free wiring of all consumers' premises by the undertakers. In England, where gas authorities have been so long at work, enabling them to secure so firm a hold upon the small consumer, it is, of course, imperative that it must be made as easy and cheap to change over as reasonable safety will permit. The extreme competition among electrical contracting firms is doing much to keep down the price, and to raise the indignation of organized contractors, and it may be bringing down the quality of the work installed.

Many of our electric lighting authorities have but touched the fringe of the business so far as the private lighting small

consumer is concerned. A number of them have conducted experiments to watch the value of supply to small property. One of the latest steps in this direction is announced from Swansea, where some workmen's dwellings which are being built on the hollow-concrete-block plan are being wired, giving the tenants the option of slot meters, calibrated for six pence per unit. Some other authorities, who have incurred outlays of a somewhat similar kind, are being hauled over the coals by critics because the incoming tenants in the small property so wired have not thought it worth while to avail themselves of the supply at the price per unit charged, in spite of the fact that the wires and lamps are in position awaiting their use.

How far publicity campaigns can be relied upon for bringing in new consumers of the smaller class is a very questionable matter. Indeed, aggressive campaigns of this kind are not welcomed in England, either by lighting authorities or by lighting consumers. There is a more promising scope for them just at present in the power field, but even there the Britisher is a delicate subject who requires skilful, diplomatic handling. He is not to be netted by any kind of literature that tells him that he is an ignoramus or a fool, or that in sticking to old methods he is doing foolishly. A fool he may be, and may know it, too, but he is the more likely to continue foolishly if he be told that he is so by the man who is seeking to profit by his turning over a new leaf.

The coming of the metal-filament lamp, however, gives one of the best chances for publicity pamphleteering, for it is by some such means that the pounds, shillings and pence side of this lamp is going to be fully and speedily appreciated by the present small consumer of gas. Some central station men have shown no overweening anxiety to boom metal lamps, for obvious reasons, but none of them would favor a continuance of that policy for long. If the new lamps are going to reduce the cost of electric lighting to the small consumer so that he can adopt it without an increase in his quarterly bill, it can not fail to bring about an enormous amount of additional mains-laying and house-service work, for few English lighting authorities have more than touched the fringe of the business that he represents. Very large numbers of streets in which mains are not yet laid comprise, for the greater part, small-class property where gas-pipes and fittings are installed, where a gas stove is in vogue for cooking purposes, and where, if electricity were adopted for lighting, the gas stove would still be required, as electric heating and cooking are regarded as a luxury.

With this class of consumer it is almost solely a matter of pounds, shillings and pence; convenience, cleanliness, greater healthiness and all that are in many cases matters that, short-sightedly, of course, they do not care a brass farthing about. As to the standard of illumination being raised, they have the incandescent gas mantle and there is no good in blinking the fact that it seems to answer their purpose, so that it must be more the argument of cost than any other that will appeal to them.

Only a comparatively small proportion of these people are the owners of the houses in which they live and they will not run to the cost of installing electric light into premises which, either perforce or by choice, they may vacate in a very short time. So the landlord is frequently the person to bring persuasive pressure upon. But apart from the cost of installation, which is a very considerable obstacle, there is that quarterly account which is a far more impressive difficulty.

The foregoing comments relate to property which has stood for from twenty to forty years or more. To-day builders of a great deal of new property are wise enough to wire straight away, so that the tenant is not concerned with the cost of installation; the gas stove is hired from the gas company. The electrical contractor gets a hint that new buildings are to be erected, and he is on the scent if the premises are to be reasonably near to the supply mains; if the builder or architect happen to be undecided as to illuminating arrangements he is compelled to give full thought to electricity by the attentions received from the aforesaid contractor. No doubt many a new electricity consumer is being secured in this way.

It is becoming patent that it is imperatively necessary that there must be the utmost simplification of charges and supply arrangements to help in the forward movement, as W. M. Mordey, the president of the Institution of Electrical Engineers, has lately remarked. At Marylebone some very plain advice has been given concerning the necessity for exercising great care at the present time lest indiscreet changes in the matter of charges for energy should disturb relations with existing consumers. The fact is that while engineers are awaiting the effect of the use of the new lamps they can not afford to lose a single customer. Systems which are dependent mainly—or to any very large extent—upon lighting, are reckoning upon a decreased rate of increase in units sold, and some will be satisfied if there is not an actual decrease in output, but the full effect will not be felt all at once, and by the time it is making any very deep impression the existence of the "wire" lamps and their economy will have become more common knowledge among potential smaller consumers, while we may also hope that the initial cost of the lamps will fall so as to give a compensating impetus.

The lamp makers are proceeding with their arrangements for the manufacture of the new lamps on a large scale in England, but until the completion of factory equipment for this purpose large numbers are being imported from the Continent. The lamp makers are, of course, displaying considerable energy in pushing the sale, and the testimonials that they have received and are publishing from consumers, are eloquent concerning the economy in their bills for energy. In one case a consumer states that in his premises he is doing for £16 per quarter what formerly cost him £56; and numerous others produce returns showing an actual economy of fifty per cent in their payments, with a superior illuminating effect. There may be exceptional cases, such as one the writer learned of recently, where the lighting cost comes out at a higher figure, but other circumstances than the lamp itself must have been to blame, although complaints as to breakage are pretty frequent. Their extra liability to breakage in transit, perhaps due to inefficient packing, is also occasionally referred to, but these can have little force against the tide that is beginning to flow in metal lamp favor.

One of the outstanding features of British electric lighting business at the present time is the slackness of orders for new generating plant. Very few new public supply systems have been set up during the last year or two, for reasons that need not here be stated, and the engineers of some of the existing installations are nervously holding their hands in the matter of extensions to plant. It was recently stated at Hull that before making particular advance of this description the corporation awaited experience in regard to the effect of the new lamps. It is safe to say that many other engineers are seeking guidance in the same way. Mr. Talbot, in his presidential address to the Municipal Electrical Association a few months ago, remarked that the electrical plant supply would feel the effect, and he is proving to be correct. But the munic-

ipal authorities and companies who sell electricity are also feeling the effect upon their finances. Already the price of electricity has been forced down to too low a figure for reasonable profit to be earned upon its sale, and reduced consumption has in some places led to suggestions for raising the charges to the consumer who uses the new lamps. This course meets with little approval. Some authorities will be helped this year to bear the loss of revenue by the reduced cost of their coal bills, which last year were exceptionally heavy, and when comparisons have to be made this factor will require attention. The attitude of the investor who has put his money into electric lighting companies seems to be one best described as suspicious hesitation. The new lamps can not be an immediate dividend-earner, so they do not lend strength to market prices of shares; they may raise values in years to come, but it is only the shareholder who means to hold on who cares much about the future. It had been thought that after so many blows received in recent years electric lighting investments were due to take an upward turn, but it seems that it is this nervousness regarding the metal lamps that stays the movement. So that the financial position of electric lighting business in England just now, whether municipal or private, is not all that one could desire. Municipalities in some towns have become weary of carrying an electric lighting undertaking round their necks, and are inclined to receive affectionately the financier who makes an offer from a company. One of the most amusing and instructive commentaries that could be passed upon municipal electrical enterprise, and its changing moods and fancies because of changing councillors, is recorded at Bath. Here many years ago a company obtained powers and supplied the town, but it was everlastingly heckled and persecuted by the corporation until at last it sold to the latter body. It has had its run, with the city rates carrying the burden, and has just entered into contracts with private parties, who will buy the undertaking and work it through a company!

Reverting to the question of simplification of charging systems, it is clear that the maximum-demand system is going more and more out of favor. It is out of favor with the consumer because what he wants is something that he can understand without an effort, and a flat rate, however inequitable it may be thought in some cases, seems to give him less room for harboring a suspicion that he is being "done." It is out of favor with the engineer because so much depends upon his being able to satisfy his consumer. Some engineers are advocating the "contract-demand" system, one of whose points would be the equalization of quarterly bills—which might or might not avoid complaints. But space does not permit of a disquisition on charging in this article —it is sufficient to indicate that the whole subject is in process of development.

One of the satisfactory effects of the lamps so far has been the increased attention that has been devoted to isolated installations for smaller country houses, hotels, and so forth, on account of the lessened cost of plants consequent upon the increased illuminating power from a given energy consumption.

A matter in connection with interior illumination that has received more attention on your side of the Atlantic than on this is the part that may be played by illuminating engineers in the improvement of existing installations by effecting a better distribution of a consumer's lamps, and so on. Undoubtedly there is a good deal of useful work to be done in this direction, reducing waste and increasing satisfaction with electricity as a lighting agent, but there are wanting indications of a burning anxiety on the part of owners to engage a specialist of this class.

Progress is now being made very satisfactorily with electricity for street lighting and open spaces generally. The effects of the improvements introduced by the inventor and the lamp maker are very plainly apparent in this department. The innumerable types of flame arc lamps, the Nernst and tungsten lamps, are aiding the electrical engineer in making an advance, and an examination of the most recently compiled statistics shows that these are all having a pretty extensive trial in different cities. We do not go in for many thousands of arc lamps in a town yet, as you do, but a number of small places count their Nernst and flame lamps by some hundreds, while the metal-filament lamps are being very extensively employed for experimental purposes, and if they pass through the ordeal well, public electric lighting in England will advance far more rapidly than it has done. Engineers are, of course, feeling their way in the matter at present. At Colchester, for instance, Nernst lamps are being replaced by Osrams as street lamp renewals become necessary. At Brighton some hundreds of street lamps have been changed over to metal filaments.

By far the finest object lesson that the public has ever had in this country in illumination systems is that to be seen at the Franco-British Exhibition in London. Both gas and electricity are well represented in the lighting of different parts of the grounds—the court of honor has a fine electrical display by arc lamps, and the electric illuminating effects generally are making a good impression upon the public mind. Then inside the machinery hall model houses fitted up respectively by the gas and electric lighting authorities are to be found, and the visitor has an admirable opportunity of comparing the merits of the two systems.

The Illuminating Engineer.

By Albert J. Marshall, Chief Engineer, Bureau of Illuminating Engineering.

THE illuminating engineer and the principles which he is advancing are receiving, at this time, more of the careful thought and attention of architects, engineers, central station and gas men than ever before. This recognition has been brought about through the fact that the competent illuminating engineer has been able to demonstrate that it is within his ability to predetermine with much accuracy the resultant illumination from any artificial lighting installation, and at the same time produce an effect as a whole pleasing to the eye. Many of those people whose business it is to specify the use of artificial light, in its various forms, are now beginning to appreciate the fact that through the medium of good illuminating engineering principles, desirable results may be obtained, obviating almost entirely the probability of failure not uncommon where the old hit or miss, or trust-to-Providence principles are in vogue.

It is only recently that the average person whose business it was to specify the use of artificial light gave little or no thought to the value or need of such services as the competent illuminating engineer could offer. But those people who

did make use of such services obtained such results that it practically compelled reluctant coworkers to acknowledge that the illuminating engineer *did* have something of value to offer and that his services or ideas in many classes of work were practically indispensable.

There were many, and there remain quite a few, people who felt that it was, and is, unnecessary to consult with a recognized authority on illuminating engineering to make use of artificial light. The large percentage of this class are persons who have been "handling" lighting problems in a hit or miss or trust-to-Providence manner for a number of years, and they have become so accustomed to using light in this manner that they have come to consider it something which requires no special skill or marked ability to intelligently make use of same. These people, feeling that light is not tangible, regard it much in the same manner as Little Eva did her existence—it just happened, and is not subject to control. To this class of people the retaining fees of the illuminating engineer are considered an unwarranted expense.

Another class of people who have been rather skeptical, but who, it has been found are rather easier to convince, are those who, in making use of artificial light, have realized that it was possible, in some manner of other, to approximate what a light source, when installed under various conditions, would do. This class often made use of certain rough formulas (based, however, on scientific data) in their work, which sometimes they were willing to discard when newer and better formulas were brought to their attention. One difficulty, however, with this class of people is that after they accept a formula they apply it without variation to all manner of installations coming under a general classification. Almost all formulas used by the illuminating engineer to-day are subject to variation, depending on conditions, and that variation is to be determined by the general experience and ability of the engineer. Therefore, any one using such formulas without taking into consideration necessary variations find that the results vary greatly, which, of course, is not good engineering. However, the people who do make use of such formulas as have been given to the public quite recently by competent illuminating engineers, are much surer of success than their coworkers, who still rely on the old hit or miss principles.

There is still another class of people who make use of artificial light, and who, apparently, use neither of the methods employed by the two. I refer to that class of people who in using artificial light subordinate almost everything to æsthetic ideas. It is reasonably safe to state that in many instances where light is used the utilitarian as well as the æsthetic should be given consideration. One seldom sees a lighting system where it would not be possible without sacrificing beauty to utilize some of the light to produce useful and desirable illumination. In other words, one seldom sees a lighting installation, unless it is purely decorative, wherein the utilitarian should be entirely subordinated to the esthetic, or *vice versa*.

This naturally leads up to the point of who must decide when the question arises whether the utilitarian or æsthetic should receive the greatest consideration; and who, might I ask, is better qualified to answer such a question than a competent illuminating engineer.

It is but recently that a few scientific men began to realize that artificial light was being used in a most wasteful manner. Realizing this condition of affairs, they began to look about for a remedy and it was principally through the application of scientific principles that the remedy was first discovered. It was the technical man, chiefly the electrical enginer, who began to make experiments in order to determine what might be done in order to eliminate this waste of artificial light; and he, naturally, because of his education and training, made use of scientific principles in attaining the desired end.

In fact, the engineer at that time gave little or no thought to anything other than the purely scientific features of the case. This I think, we can readily understand, was natural when we consider the vast improvements that the engineer saw could be made through this medium. The engineer, essentially of technical and scientific mind, up to this time had had no cause or reason to make a study of æsthetic principles, inasmuch as he had never had occasion to apply such principles to his work. As it was the engineer who first appreciated what could be accomplished by the proper use of artificial light, new systems and methods of use suggested by him were strongly impregnated with his views, his ideas. These new methods and ideas that the illuminating engineer was offering and putting into actual use were applied at first, principally, to so-called commercial lighting installations, wherein the utilitarian side was of prime importance. After a number of such installations were made it was noted that improvements on the side of economy were showing up to such advantage that the same principles were then tried out in classes of service wherein the utilitarian was *not* of such great importance. In some instances these principles were made use of by people who did not have the training or natural taste to fully appreciate the æsthetic, the result being that while the installation from an economical point of view was almost entirely satisfactory there was something to be desired in the effect as a whole.

About this time users of artificial light in work wherein other than the purely utilitarian was of first consideration, came to the fore with the general statement that the scientific mind was unable to fully appreciate the beauty and harmony that work of this nature demanded; that it was all right for the illuminating engineer to handle lighting problems where the utilitarian was the main consideration, but when it came to specifying lighting systems for such places as churches, theatres and public buildings the illuminating engineer should recognize his inability and permit those with a highly trained artistic sense to take charge.

The outcome of this controversy was that men who could and did appreciate the ultimate sphere which the competent illuminating engineer would eventually reach, began to study this new science and art from all points of view, so that they would fully appreciate not only the utilitarian and æsthetic, but the psychological as well. There being no schools or colleges where one could go to learn the principles and applications of this new art and science, it was necessary for these men to supplement their already wide experience with keen observation and close application to the study of all theories presented to assimilate the really desirable knowledge necessary for this new work. He must be able to appreciate what is meant by simplicity, beauty and harmony; to be able to see through the eyes of the architect and to so work as to assist the architect in accomplishing the most desirable end; to understand the eye, for if the eye is not given due consideration work done will be for naught.

The illuminating engineer of to-day, and I speak of that type of engineer who is competent to discuss intelligently illuminating engineering principles in all its many phases, because he has made a study of the work, is here to stay because he is necessary to success in the use of

artificial light. This type of engineer is not merely a man of figures, but one who can and does cause beauty to be reflected from his ideas.

The illuminating engineer, generally speaking, has got to look to the architect for the bulk of his work and, realizing this, it is necessary to convince the architect that he is capable of carrying out any and all work which the architect may place in his hands. It has been an up-hill fight to convince the average architect that the services of a competent illuminating engineer are desirable, and often indispensable in many classes of work, and it is most gratifying to note that there are to-day architects of recognized ability who have given the illuminating engineer a chance to demonstrate his value and the results which were thus obtained warrant other architects taking up the ideas which the illuminating engineer can suggest.

I do not know of a single instance where the architect, when he consulted with a competent illuminating engineer, had reason to regret it. Unquestionably the day is rapidly approaching when the illuminating engineer will be firmly established and those who appreciate his value will gain over their reluctant brethren.

The Carbon Flaming Arc.

By Thomas Spencer, Chief Engineer, Helios Manufacturing Company.

ALTHOUGH the term luminous arc has been applied to a much larger field than formerly, including, as it now does, lamps in which the electrodes are of other substances than carbon, and in which the light is given from the flame rather than from an incandescent crater, the term flaming arc seems to be applied only to the earlier form in which the electrodes are carbon impregnated with the salts of alkaline earths.

This form, which is the subject of this article, has now been a commercial possibility for something like five years and has been upon the American market for a little more than two years. Abroad it has made great progress and lamps of this character can be seen burning in great numbers in all of the large cities, but here the introduction has been comparatively slow. It is true that a few can be seen on the streets of our principal cities, used mostly for advertising purposes, but still the number of lamps used is very small compared with what you would expect for a source of illumination whose efficiency is so much higher than any other.

The principal reason for this, in my mind, is the short life of the carbons.

The complete replacement of the open arc with us, by the enclosed, has so accustomed our people to an arc lamp which has a long life that one which requires frequent trimming is not attractive, no matter what its other good qualities are.

Abroad this does not apply as the enclosed type of lamp has not obtained the footing it has with us.

There is another reason perhaps which has contributed to lessen the rapidity of their introduction and that is that the lamps which were first brought to this country were of a type known as the clockwork pattern. This form is looked upon here as much too delicate to long stand the hard service to which arc lamps are subjected, but no doubt the short life of the electrodes is considered the greater drawback.

In some of the early lamps, the light-giving salts were mixed through the body of the carbon and in large quantities. This was found to give a great amount of light, but unfortunately when the lamp was turned off it would not light again on account of the insulating slag that was formed upon the ends of the carbons. To overcome this an attempt was made to break off this slag by means of a mechanical device worked by a magnet, but this was not very successful.

Then an old form of lamp in which were two carbons pointing downward at an angle to each other was tried, the supposition being that the slag would drop off as fast as it was formed, leaving the points of the carbons clean. Although this was a great improvement over the carbons placed one above the other, the difficulty still continued and it was not until after the German carbon makers had taken up the manufacture of this type of carbon and had discarded the form in which the light-giving salts were mixed throughout the body of the carbon and had substituted one with a core containing the light-giving salts that this trouble began to disappear. It was soon found, though, that this type required the carbon to be the smallest possible diameter to secure steady burning, and this small diameter, of course, as it will easily be seen, reduced the time of burning of a pair of carbons of a given length, so, to obtain even a practical life, the carbons had to be made of an unusual length and, of course, with a corresponding increase in the length of the lamp.

Another difficulty which the small diameter of the carbons introduced was the large variation in resistance which they caused in series with the arc which very much interfered with the regulation of the lamp.

To remedy this, copper plating of the carbons was first tried, but this did not seem to meet the conditions. The solution was finally found in the introduction, either in the core or in a special opening running the whole length of the carbon, of a metallic wire which in some cases was zinc and in others brass, depending upon the makers. In spite of all of these improvements the objection still remained of a long, delicate carbon. To remedy this a great many inventors have tried their hand at what are known as magazine lamps; *i. e.,* lamps in which a number of carbons are placed in a magazine, only one carbon burning at a time. As soon as it is consumed another takes its place automatically from the magazine, and this continues until all the carbons in the magazine are consumed. Quite a number of lamps of this character are in operation abroad, but on account of their necessarily complicated structure it is evident they are bound to be troublesome in operation.

Another set of inventors have tried burning a number of pairs of carbons in parallel, the arc shifting from one pair to the other as they burn away. While this is much simpler than the magazine form it involves considerable difficulty in the control of the arc by the blow magnets, which control is absolutely necessary to produce steady burning.

If, instead of a number of carbons, only two pairs are used, this trouble is overcome and, in my opinion, the most practical solution of the life question is obtained, as with two pairs of carbons of reasonable length a life of between twenty-five and thirty hours can be obtained with a lamp whose length is only a few inches longer than the average enclosed lamp.

Our friends across the sea, from whom we received our ideas of the flaming arc lamp, realized that their solution of the problem, as far as the lamp was concerned, was rather a complicated one, but they

think there is no way of accomplishing the results other than by the so-called clock-work mechanism.

It is quite true that several types have been developed which do not use the clock-work form, the feeding of the lamp being accomplished by letting one carbon rest upon a support at its burning end, the carbon feeding down as it burns away by gravity, carrying with it the other carbon to which it is attached mechanically. This form of lamp has taken a great many shapes, according to the ideas of the inventors. In a number of cases special forms of carbons are used, while in others the simple round carbon is retained. This lamp has a number of good features, the principal one being that it can be operated in series without a shunt coil and, of course, this principle leads to great simplicity in construction. Unfortunately experience has proven that the burning of the carbons is much less regular and reliable than when the carbons are burned free with no support. This is even the case with those lamps using the special forms of carbons, and the use of any special carbon is a serious objection in itself. From what I have said it would therefore seem that there is some middle ground in the construction of a flaming arc lamp between the clock-work lamps of the Germans and the so-called gravity-feed lamp which we have just described which will be the final form which this type of lamp will assume.

Considering the improvements made, which I have pointed out, it would seem that there should be a large field in this country for this form of illumination, as there is no question that the volume of light obtained for the energy expended is the highest obtainable. The golden yellow color, the form usually used, has proven extremely pleasant to those who are compelled to work under such an illuminant and, besides this, the color is particularly suitable for illuminating such places as are dull from dirt and soot, as more light is reflected from such surfaces with this color than with ordinary white light.

I feel that when these points are fully appreciated by the American people that the flaming arc lamp will be much more generally used, even more than it is abroad.

A New Field for the Electric Sign.

By Benjamin Wall.

WHILE it is pretty well understood that many progressive business men of to-day do not consider an establishment complete without a suitable electric sign burning either a name or a business into the mind of the public every night the store is open, it is not so well known that there are numerous electric signs now being used in lower Manhattan as "business-getters" that burn all day from the opening until the closing of the store.

The streets of New York are somewhat narrow, but the same statement applies to a number of other cities of importance in this country. Narrow streets with tall buildings and the resultant darkened area give the central station sign man an excellent argument when advocating the use of the electric sign for daylight advertising.

A Nassau street clothing-store proprietor uses an electric sign containing 125 eight-candle-power lamps, the sign being placed flat against the building, and although the show window beneath is brilliantly illuminated the sign burning in the daylight attracts the greatest attention and has added considerably to the business of this house since its installation.

A well-known retail drug store in lower Manhattan has for some time maintained a panel sign in front of its window. This sign is lighted from 8 A. M. until the store closes at night and is a prominent feature of the advertising display made by this firm.

In the shoe store of Frazin & Oppenheim in New York city may be seen another electric sign burning all day over an archway leading from the main store to their annex.

Another case of daylight use of the electric sign may be observed in Brooklyn. The Abraham & Straus department store

A Daylight Electric Sign.

has an entrance leading from the subway directly into its store, and it has installed an electric sign with the firm's name in electric letters over the doorway. This sign does double duty, as it burns all day during business hours and at night, even when the store is closed.

The outside stock exchange, known as the "Curb," which holds its meetings in the open air on Broad street, south of Exchange place, in New York city, has been a cause of complaint on account of noise to the occupants of office buildings nearby. To end this trouble S. Mendel, the "dean" of the "Curb," decided to use an electric call sign. Each brokerage firm was given a number, and a blackboard, equipped with incandescent lamps under the firm's number, may be seen from both sides of Broad street. If the representative of Mendel & Company is wanted at the telephone, their number is flashed on the electric sign, and until the call is answered the number remains displayed on the electric call board.

Anent the general use of electric signs, the illustration of the first electric sign in New York city, shown herewith, is interesting. This sign was installed some twenty years ago at the spot where the so-called "Flatiron" Building now stands, at Broadway, Fifth avenue and Twenty-third street.

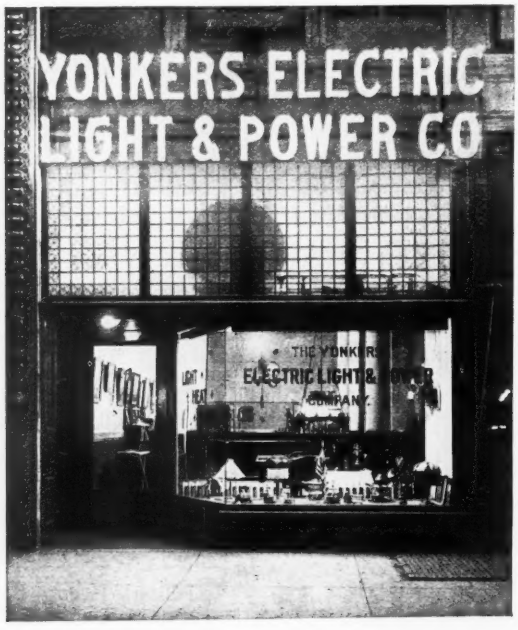
Part of this sign was flashed and there is an interesting little story connected with the flasher that was in use here, it being stated that instead of commutators, gears and motor now in universal use for flashing electric signs, the flasher for the first sign was operated by hand-power. Knife switches were installed for each circuit of lights and a young man employed to pull the switches until one line of letters was flashed, then he closed the switches, thus lighting the entire sign. This was done from dark until midnight every fair night and must have been a very irksome task for the "human flasher."

So confident was the Garden City Estates Company that an electric sign

would prove beneficial to its business that it insisted on a clause being inserted in its lease giving it the privilege of installing an electric sign in front of the windows of its suite of offices on both sides of the building on the north end and willingly paid a higher rental for the privilege.

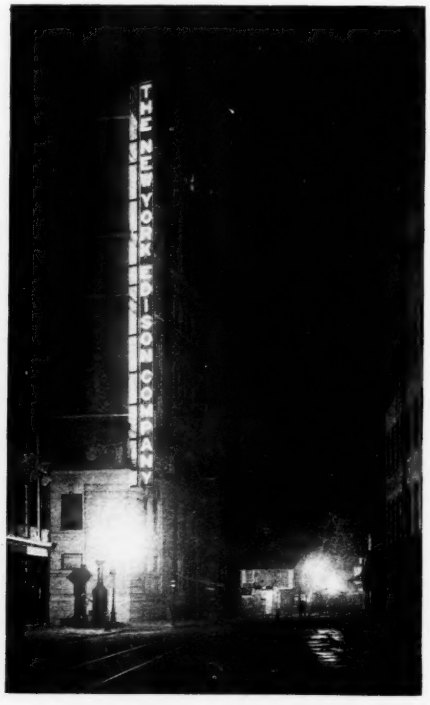
The New York Edison Company has the honor of using the largest vertical electric sign in the world. It is built in four sections and is 100 feet high, with letters twenty-four inches high studded with electric lights. This sign, with the large electric roof signs on all four sides of the Duane street office building, gives that section of Manhattan the appearance of being on fire at night.

One of the notable electric signs on the river front is that of the Heinz Pickle Company. The letters "Heinz" are fourteen feet tall and the numerals "57" are each twenty feet high by fifteen feet wide. This sign can easily be read by day or night from Hoboken and Jersey City and from all the ferryboats plying on the Hudson River, and, like the Colgate sign in Jersey City, is a landmark of the sky line of lower Manhattan.



How One Electric Light and Power Company Takes Its Own Medicine.

The First Electric Sign in New York City.



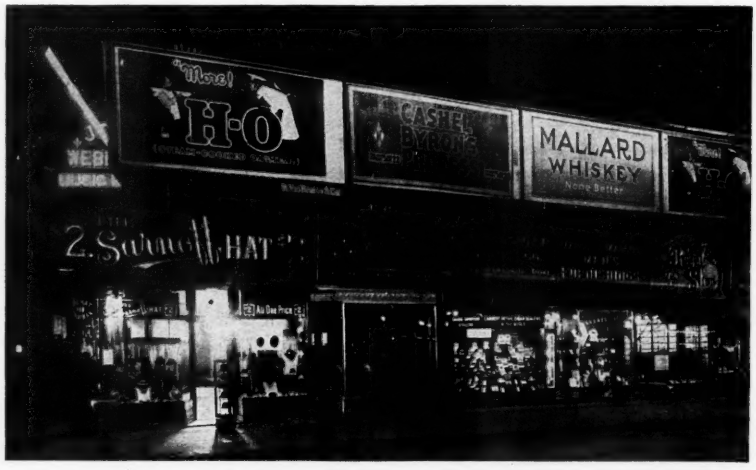
The Tallest Electric Sign in the World.

Central stations throughout the country are using the electric sign more than ever, thus setting an example to the merchants of their cities, and even the gas companies are taking up the electric sign to advertise their product.

On One Hundred and Twenty-fifth street the Consolidated Gas Company has installed a large vertical electric sign reading "Cook with Gas." The Municipal Gas Company, of Albany, N. Y., has a similar electric sign in front of its office building. The Public Service Corporation of New Jersey has recently placed in front of its Passaic office building a vertical electric sign reading "Use a Gas Range." All main line trains of the Erie Railroad pass within two hundred feet of this building and the sign is read at night by thousands of passengers.

The Utica Gas and Electric Company has one of the best advertising signs in the country. On the smokestack of its power station in Utica it has installed an electric sign of the skeleton-letter type reading "Utica Gas and Electric Company." It can be read at night for several miles and is an excellent daylight sign on account of its great size.

The Yonkers Electric Light and Power Company has installed a large electric roof sign as well as a flat box skeleton-letter sign in front of its office building. The roof sign can be seen both day and night from almost any point of the Highlands across the Hudson and from all Hudson River steamboats.



A Well-Illuminated Bill-Board.

In Greater New York a recent ordinance has compelled the reduction in the size of sidewalk electric signs to six feet at right angles from the building. The

United Cigar Stores Company had a number of electric signs in front of its stores that exceeded this limit and the writer visited several of these stores with the cigar company's electrician to see what could be done to so modify the signs as to bring them within the requirements of the new ordinance. It may be worth while to relate here the gist of a conversation which occurred between one of the cigar store company's managers and their electrician on one of these visits. The manager stated that he hoped his sign could be fixed speedily, adding "since that sign has been up I have done fifty dollars a week more business in this store." This was with a sign that represented an investment of about $75 for the sign and necessary service wiring.

The New York *Herald* has recently placed a V-shaped electric sign in front of its One Hundred and Twenty-fifth street branch office. The New York *Evening Post* one on the roof of its beautiful new office building in Vesey street. The New York *World, Staats Zeitung, Press, Times, American* and Brooklyn *Daily Eagle* and Brooklyn *Citizen* have all installed electric signs on their main and branch offices, and there is no question that they feel it is a profitable method of advertising.

A view of a section of bill-board reflector lighting is shown herewith. These reflectors are at the northwest corner of Broadway and Twenty-eighth street, New York city—well known as the site of Weber & Fields' theatre. The bill-boards are ten feet high and the reflectors five feet from the bill-board. For a cheap and satisfactory method of advertising by day and night nothing has yet been devised that will take the place of the electrically illuminated bill-board. Placing the lamps one foot apart (using either four-candle-power or eight-candle-power lamps) will give all the light required with reflectors at a distance of five feet to properly illuminate a ten-foot bill-board. The lamps used in this illustration are eight candle-power.

The first recorded instance of the use of tungsten lamps in sign lighting is that of the New York Edison Company, which is just installing a sign reading "Tungsten Lamps" on its branch office in West Thirty-second street, equipped with twelve-volt, twenty-five-watt tungstens, operating ten in series.

In closing, the writer considers the following account of an incident related by a manager of a central station sign department of possible interest. The customer occupied the basement of a three-story building. He ordered a panel sign from the central station, the sign to be erected over his door. To do this safely it was necessary to use guy wires which ran across the windows of the floor above. The tenant on this floor objected to this and the central station man was threatened with a cancellation of the sign contract. He was so well satisfied that the sign would benefit the customer who had ordered it that he suggested and was able to convince his customer that even if he had to rent the other floor it would be better to do so than to give up the sign. The customer was able to secure a lease of the floor above and to-day occupies the entire building, where only two years before he was able to handle all business that came his way in the basement. He has the electric sign and would not part with it under any circumstances.

Luminous Arc Lamps.

By G. N. Chamberlain.

THE luminous arc, sometimes termed magnetite arc, metallic-flame arc, has for some time been admitted by the most conservative or sceptical to be out of the experimental class. Although through the early stages of development, the system was received with scepticism by many of the leading illuminating engineers and arc-lamp manufacturers, it has long since been acknowledged as the most reliable and efficient illuminant available for outdoor services. At the annual convention,

FIG. 1.—CONCENTRIC RING REFLECTOR.

held in Chicago, May, 1908, the National Electric Light Association accepted the report of its committee of representative illuminating and central station engineers, which placed the luminous arc in a class by itself and far ahead of all the other out-door illuminants investigated.

The many points of superiority claimed for the system have been expounded in detail, both by the representatives and publications of the manufacturers, and the interesting phenomena of the luminous arc itself have been discussed at length by the technical press. A repetition of such details is therefore unnecessary as the data can be secured through the channels mentioned. Several years' commercial operation has resulted in the introduction of refinements into the series luminous system. Fig. 1 illustrates a concentric ring reflector designed for use with the series luminous arc. The superior distribution of light resulting from the use of this type of reflector in connection with the carbon arc has led to its application to the series luminous lamp. The use of the reflector, while maintaining the same lighting distance previously attained, assures an evenly diffused light and absence of shadows in the immediate vicinity of the lamp.

Fig. 2 illustrates a well-known form of copper upper electrode. The diameter of the copper has been increased from five-eighths inch to three-quarters inch and entirely enclosed with the exception of the burning ends, with one-sixteenth-inch iron casing. The use of the extra amount of copper and the prevention of the rapid oxidation of the same by the iron sheath have increased the life of the electrode to about 6,000 hours, or approximately fifty per cent. While no radical changes have been made in the design or manufacture of the lower electrode, a more uniform product and a gradual increase in life and efficiency are being obtained.

Fig. 3 represents a street lighted by luminous arcs and is one of the many

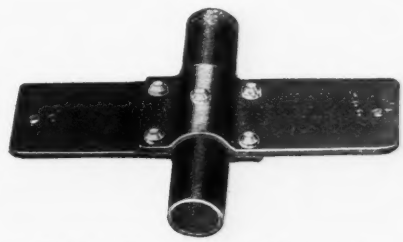


FIG. 2.—COPPER UPPER ELECTRODE.

installations in successful operation throughout the country. The system has not only been adopted by the smaller towns and average-sized cities, but has been accepted by the larger representative cities of the country.

The following extract from a daily paper of recent date is representative of

the expression of universal approval with which the system is received:

"On Saturday evening the new electric street lamps were turned on after having received a good test and found entirely satisfactory by the superintendent and the electric light committee.

"The system that furnishes the light is the newest on the market, and its simplicity of construction and operation is apparent even to the layman.

"This new type of lamp is particularly suited to street lighting. It has a small power consumption, four amperes, at seventy-five to eighty volts, being about one-third less than the old lamps. Everybody has noticed the uniform lighting of our streets and commented thereon. There are hardly any shadows in the streets between the lights. Combined with this new lamp is the efficient transformation of alternating current into direct current by means of a mercury arc rectifier.

"Ordinary carbon electrodes are rejected in this system. To explain the operation of the lamp would be to give the reader a lot of technicalities, which are unnecessary in view of the fact that the lights work exactly as represented by the installing company, and that the people are very well pleased.

"The superintendent says that these lamps will need trimming but twenty times a year, and that the department expects to run at least 3,500 hours a year.

"Council had a number of systems to choose from, but all the members were unanimous in picking the luminous and not one has any complaint whatever to make. All over town the people are commenting on the uniformly bright lights and are expressing themselves in high terms of praise on the electric light department's acquisition."

So marked has been the success attained by the introduction of the series luminous arc, that it has naturally lead to other applications. Conditions often exist where it is prohibitive or at least undesirable to install a high-potential series circuit, but where otherwise the luminous arc would most efficiently and satisfactorily fulfil the requirements. To meet such a demand there exists a lamp suitable for maintaining a luminous arc on direct-current circuits of nominal 110 volts or multiples thereof.

Fig. 4 illustrates a type of lamp available for multiple or series-multiple operation. For single operation on 110 or 220-volt circuits the lamps are connected directly across the line, the difference between the two lamps being that of windings and adjustment.

Besides being operated singly on 220-volt circuits, two lamps may be connected in multiple-series and such connection is necessary where higher voltages only are attainable. The arc proper has all of the characteristics and advantages of the series luminous arc and the lamp is representative of the most modern arc lamp engineering practice.

The casing is symmetrical in construction, of pleasing appearance and so arranged as to admit of the use of the twenty-six-inch concentric diffuser, the advantages of which have long been acknowledged in connection with the distribution of light from the enclosed carbon arcs.

This type of lamp is especially recommended for the lighting of foundries, freight yards, machine shops, train sheds, freight houses, drill halls and riding academies, or, in general, for the lighting of large areas where the fumes would not be noticeable.

The luminous arc is also found to be ideal for city street and interurban headlights. This application of the luminous arc is the result of the constantly increasing demand for a more efficient and reliable headlight than could be obtained with the enclosed carbon arc. The track illumination is very satisfactory, the headlight not only illuminating the track for a distance of 1,200 to 1,800 feet ahead of the car, but the beam is exceptionally broad. The peculiar characteristics of the luminous arc are such that by reversing the current, thereby making the copper electrode negative, the light is reduced to such an extent as to make it suitable for city service. This is readily accomplished by a reversing switch installed in the car vestibule near the motorman.

The maintenance of the enclosed arc headlight for cars has always been comparatively high on account of excessive globe breakage and resulting rapid consumption of carbons. A life of 2,000 to 3,000 hours for the positive electrode, fifty to seventy-five hours for the negative electrode, together with the absence of all enclosing globes, is readily appreciated as shown by the number of present users of the luminous arc headlights.

Another type of luminous headlight has been designed for mining locomotives, which is also available for use in localities where a heavy cast frame of small dimensions is required for protection.

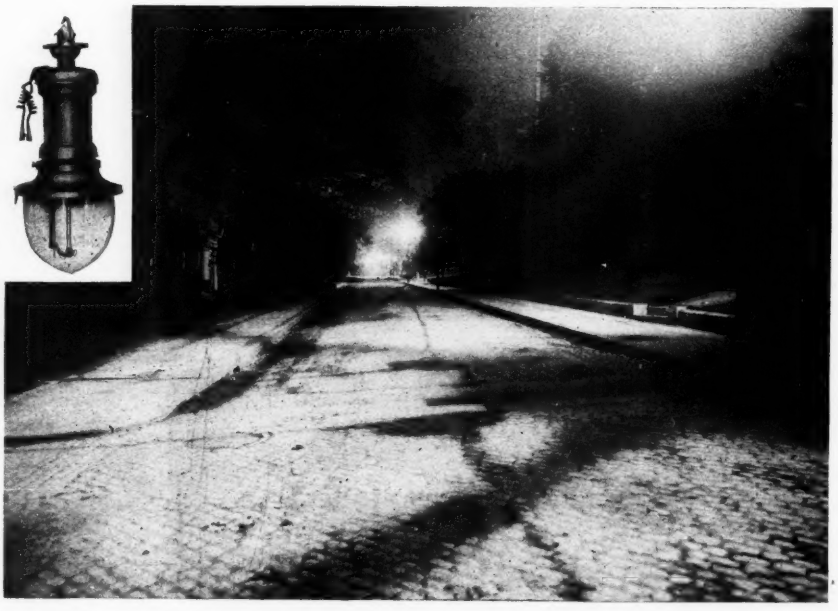


FIG. 3.—STREET LIGHTED BY LUMINOUS ARCS. THE LAMP SHOWN IS FOR SERIES OPERATION.

FIG. 4.—LUMINOUS ARC LAMP FOR MULTIPLE OPERATION.

The Helion Lamp.

By Professor H. C. Parker and W. G. Clark.

WHILE the difficulties encountered in the experimental investigations involved in the development of the Helion lamp have been very great, such progress has been made that we feel that commercial perfection is rapidly being approached. Early in 1907 we exhibited the first Helion filaments upon which a satisfactory life was secured. These were extremely sensitive to the slightest trace of gas in the lamp bulb, and it was difficult to exhaust the bulbs to the necessarily high vacuum. When the lamps were burned with only a slight trace of gas in the bulbs, in the course of time a cathode discharge was set up between two points of the filament near the terminals, and this invariably resulted in burning out the filament near one of the leading-in wires. This gas which caused the trouble was contained in the cement, and was very difficult to remove entirely. After experimenting with a great many cements a process of elimination finally provided one best suited to the purpose. The vacuum apparatus was also developed to the point which the characteristics of the filament demanded.

It was realized, however, that the difficulties entailed in making such a process commercial were enormous, and a series of experiments was started on the filament itself in order to reduce its sensitiveness to the presence of gas and enable the filament to be burned in a vacuum at a slightly higher pressure than that at which the cathode rays were liable to start.

A great deal of work has been done to make filaments of a uniform composition, and to standardize methods under which they were produced, so that it could be announced definitely that invariable results could be obtained. It is now a fact that a filament has been secured which is less sensitive to the presence of gas, and this is well substantiated by the demonstration of the burning of this filament with an efficiency of two and one-half to four watts per candle in the open air without any enclosing glassware whatever. Where the heat is retained by reducing the convection currents, the efficiency, of course, increases very rapidly.

The new filament differs in some characteristics from the original Helion filament, and a tabulation is now being made of many of the interesting physical properties which are being discovered.

So much success has been attained in the production of filaments of a much higher resistance than the original filaments, that we are now able to absorb either 110 or 220 volts in a single loop of moderate length and comparatively great cross-section. This filament may be maintained at bright incandescence in the air for many hours without deterioration, at a temperature approximating 1,800 degrees centigrade. When atmospheric dust is kept away from the filament there is apparently no surface change, but when particles of dust in the atmosphere come in contact with the hot filament they are fused and stick to it, so that in the course of time the filament takes on a growth, the rate at which the accumulation develops being entirely dependent upon the amount of dust which comes in contact with the filament.

A peculiar feature of the filament is that after burning a number of hours in the air there is noticed a slight progressional change in luminosity. This begins at one terminal and gradually continues around the entire length. It has been discovered that this is due to the burning out of the carbon core on which the filament is formed. As this core burns out the tube remaining is composed of pure Helion and, as the only portion of core exposed is the end within this tube, the rate of oxidation is very slow. When the carbon core is entirely burned out, the conductivity of the filament is decreased by an amount equal to the original conductivity of the carbon core. This effect can be prevented by sealing the terminals of the filament to prevent oxidation. When this is done the filament will burn in air for a great length of time.

The specific resistance of the filament is nearly fifty times that of the carbon filament, and several hundred times that of tungsten. The filament is also very hard, it being possible to scratch glass with small particles of it under the thumb nail.

When the incandescent filament is plunged in water there is apparently no effect other than a change in temperature.

One of the unexpected phenomena which have been observed when the new filaments were mounted in a high vacuum and operated at a high temperature was the coating of the globes with pure silicon, due to an intense ionization, forming a mirror deposit. This has been overcome by giving the filament a slight coating of another material which prevents this ionization from starting. Further experiments along this line are being conducted and the results are extremely promising. One of the filaments experimented with in this manner has already shown a life of more than 600 hours at a satisfactory efficiency, and is still burning with no appreciable diminution in candle-power or change in resistance.

It has been found that a Helion filament made to operate under the conditions which produce the most intense ionization can be utilized as an "Adion" in the de Forest system of wireless telephony with most satisfactory results, and experiments are now in progress to utilize the filament as a detector in wireless telegraphy and telephony.

While the development of this lamp may appear slow, it must be remembered that between each step, as progress is made, there must be a countless number of trials, life tests and experiments, and a long period of time is required to secure accurate data and ascertain the effect of each experiment. The constant effort has been to reach a point where filaments of uniform composition and resistance, and of the highest efficiency, could be produced invariably. Considerable progress has also been sacrificed in adapting the filaments and mountings to utilize standard glassware and the standard appliances and auxiliaries now used in the production of the present commercial types of carbon-filament incandescent lamps. We have now met with such success that we feel it is entirely reasonable to assume that a commercial Helion lamp will be available in the not distant future.

In addition to the standard types of lamps, experiments are progressing with a view of adapting the Helion filament to such forms as are called for in miniature lamps, tubular lamps, headlights and searchlights. A novel construction, with which considerable success has already been attained, is one in which are used four filaments in parallel, each filament connected to a single neutral point. Where each filament is of ten candle-power the lamp originally gives forty candle-power. If one of the filaments should burn out or be broken through accident, the lamp will continue to give thirty candle-power. If another filament is broken it becomes a twenty-candle-power lamp, and when but one filament remains it is still a ten-candle-power lamp. In this way the same lamp can be removed from one circuit and placed in a position where a smaller amount of light is required, thus extending its service over a very great period of time.

Flame Arc Lamps.

By W. H. Jones.

DURING the past three years many improvements have been made in the various types of illuminants, foremost among which are those pertaining to the flaming arc. Introduced into this country as an advertising novelty, it has attracted and held the attention not only of the public at large, but of the manufacturers as well.

On account of its remarkable illuminating power and the ever-increasing demand for more efficient units the flame lamp fills a long-felt want for certain classes of illumination, especially the lighting of large areas foggy with smoke or dust. As an advertising medium it has had a marked success and will continue to hold its present prominent position until supplanted by an illuminant more efficient and more pleasing in appearance.

Flame lamps of foreign manufacture were for a time the only types known, and it did not take the American manufacturer long to appreciate the inroads being made by them into his markets. Realizing the possibilities of this type of lamp and the necessity of giving the public a lamp conforming to American standards and practice, many types have been placed on the market, among which may be mentioned the G. I. flame lamp manufactured by the General Electric Company.

This lamp, shown in Fig. 1, has the same appearance as the standard line of enclosed lamps manufactured by this company under the same trade name. These lamps are extremely simple in design, rugged in construction and reliable in operation, having, instead of the usual complicated and delicate clock mechanism, chain feed and escapement common to the foreign lamps, a screw feed arrangement which comprises but few parts and which is equally as efficient.

This arrangement of the feeding mechanism is a pronounced improvement since the introduction of the flame lamp in this country, and with equal efficiency and steadiness of light gives it a distinct advantage where maximum illumination is desired. This lamp is of the converging carbon type, and so designed that the carbons are both supported in holders and are not dependent upon buttons, stops or a special rib on the carbon itself. There is nothing below the arc to obstruct the light in any way and when the lamp is in operation the whole globe appears to be a luminous sphere uniformly illuminated.

Photometric curves made in the illuminating engineering laboratory of the General Electric Company show that the light emitted is practically equal in intensity

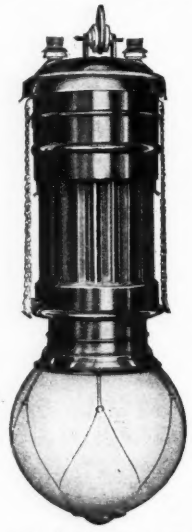


FIG. 1.—G. I. FLAME ARC LAMP.

from twenty degrees below the horizontal to the vertical position, thus permitting the lamp to be hung in a very high position and still give perfect illumination.

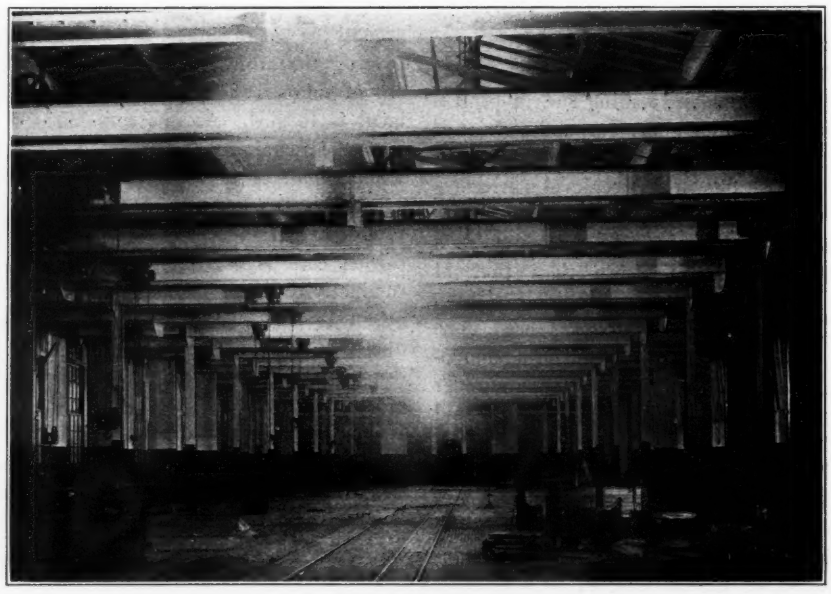


FIG. 2.—NIGHT PHOTOGRAPH IN IRON FOUNDRY, PITTSFIELD WORKS OF GENERAL ELECTRIC COMPANY. LIGHTED BY SIX TWELVE-AMPERE G. I. FLAME ARC LAMPS, RUN TWO IN SERIES ON 110-VOLT, SIXTY-CYCLE CIRCUIT. THE SPACE LIGHTED IS 264 FEET LONG BY SEVENTY-FIVE FEET WIDE. LAMPS ARE SPACED THIRTY-FIVE FEET APART AND SUSPENDED SIXTEEN FEET FROM THE FLOOR.

In view of this special advantage and the fact that these lamps have been approved by the Factory Mutual Laboratories for the Manufacturers' Mutual Fire Insurance Company, they can be recommended for illuminating machine shops, erecting shops, train sheds, ferry houses and similar places having large free areas.

Fig. 2 shows an interior view of a foundry, 264 feet long by seventy-five feet wide, illuminated by six G. I. flame lamps. These lamps are operated two in a series, on 110-volt multiple alternating-current circuits, and are adjusted for twelve amperes. They have a power-factor of seventy-five per cent, and at this value, 990 watts are consumed by each pair of lamps, or 2,970 watts for the six lamps. The total floor space illuminated is 20,670 square feet. Thus it will be seen that the actual watts per square foot in this installation is but 0.14. In order to give a comprehensive idea of the brilliancy of the illumination, which can not otherwise be given on account of lack of photometric data, the writer would call attention to the fact that he was able to read ordinary printed matter in any part of the room, and with his back toward the source of light.

The lamps mentioned above were trimmed with carbons emitting a golden-yellow light, and it should be remembered that for similar installations, or for the illumination of docks, ferries or train sheds, where the atmosphere is foggy or

filled with dust, the yellow light is much more beneficial on account of its penetrating qualities and adaptability to the human eye.

Manufacturing concerns throughout the country are seriously considering the question of illumination from every viewpoint, and in many instances have changed over their entire lighting system to flame lamps. This has been made possible by the advent of the American-made flame lamps with their excellent qualities of efficiency and economy in operation, as well as their low selling price.

Although the maintenance charges are somewhat higher for the flame lamp than for other illuminants, it is rapidly increasing in popularity, a partial reason for which is given by the data set forth in the following table:

ALTERNATING CURRENT FLAME LAMP.

Amperes	12
Volts	55
Watts at terminals	500
Hemispherical candle-power	1,167
Spherical candle-power	874
Watts per hemispherical candle-power.	0.428
Watts per spherical candle-power	0.572
Hours life per trim	12

Rapid Introduction of Tungstoliers.

A representative of the ELECTRICAL REVIEW a few days ago met E. J. Kulas, vice-president and general manager of the Tungstolier Company, of Cleveland, Ohio, west-bound on the Twentieth Century Limited. Mr. Kulas was very enthusiastic over the new Tungstolier units which are being marketed by his company. In response to an inquiry, Mr. Kulas stated that approximately 27,000 of these Tungstoliers, each meaning a complete fixture, shade equipment and tungsten lamps, had been marketed since the beginning of shipments in April. Over fifty salesmen are now devoting their entire time to the introduction of the Tungstoliers. These salesmen are working from nine established branch offices. Mr. Kulas added: "The future before this tungsten lighting system is far and away beyond our original conception. Within six months we expect to have 200 salesmen, working from sixteen or twenty branch offices, and we believe that the old methods of purchasing lamps, fixtures and the component parts of the lighting unit from several different companies will be changed, to a very great extent, by the sale of the complete Tungstolier unit. The Tungstolier will revolutionize electric lighting and make possible 'daylight' at an enormous saving in cost."

The Just Tungsten Lamp in America.

J. Auerbach, president of the Electrical Accessaries Company, New York city, returned recently from an extended trip to Europe, where he visited and inspected the factories producing the Just tungsten lamp.

The average life of these lamps is not less than 1,000 hours, when burned under proper conditions. The factories have made progress in their manufacturing methods, and the company is turning out at present the standard twenty-five, forty, fifty and 100-candle-power lamps for 100 to 125 volts, as well as the fifty-candle-power lamp for 200 to 250 volts. The company is also making a 200-candle-power and 400-candle-power lamp which should create quite a demand for the replacement of arc lamps, not only for interior lighting, but also for street lighting.

Mr. Auerbach is particularly enthusiastic over the special Type D lamp, in which the entire filament is supported in springs. This lamp can be burned at any angle, and the life of these lamps, he states, will be found to be just as great as the vertically burning lamp. The construction of the Type D lamp is original, and embodies some exclusive features obviating the difficulties which have been found in other types when burned at an angle. This type of lamp at present is made in twenty-five and forty-candle-power sizes.

From its inception the Just tungsten lamp has been distinguished by its neat design and compact appearance.

The Electrical Accessaries Company has arranged for large shipments to be delivered regularly, and the company carries in its New York warehouses about 100,000 lamps of the different candle-powers and voltages for immediate delivery.

The company expects to bring out shortly a line of special transformers of an entirely novel construction. The transformers will reduce a current of 100 to 125 volts or 200 to 250 volts to sixteen volts, thereby making it possible to install five, eight and sixteen-candle-power tungsten lamps. These transformers are so small that they may be readily attached to the canopy of the chandelier, placed on the wall, or applied directly to the lamp, if necessary. With this transformer it will be possible to install sixteen-watt tungsten lamps for direct use on any voltage up to 250. The loss caused by the transformer is about one watt per lamp. The transformers will be built for one, two, four or six lamps, and it is expected that the cost of lamp and transformer will not be greater than the present price of tungsten lamps.

The lamps will contain one heavy filament, giving an increased life to the lamp, and will also mean the introduction of the tungsten lamp in lower candle-powers.

A feature of considerable importance with the Just tungsten lamp lies in the fact that when the lamp is screwed in the socket every extending part of the base is insulated, thus conforming with the most recent suggestions of the Underwriters' Laboratories.

The company is arranging for the appointment of local agents in the larger cities throughout the country, and will have a number of the most prominent houses represent it in the various centres of the industry.

An Interesting Installation of Just Tungsten Lamps.

S. Gruhn & Company, 1947 Broadway, New York city, announce that on March 17 an installation was made in one of the largest billiard academies in New York city of sixty forty-candle-power and thirteen 100-candle-power Just tungsten lamps, in place of 165 sixteen-candle-power carbon-filament lamps. The company's client was formerly on a wholesale rate, guaranteeing a fixed amount per month. Just before the installation of these lamps he entered into a contract with his landlord whereby he purchased current at or about five cents per kilowatt-hour. When on the wholesale rate the bills averaged from $170 to $220 per month. With the installation of the tungsten lamps the average of the bills was cut to $28 to $45 per month. The total cost of renewals since March 17 has been $7.50.

The company states that there is no perceptible diminution in illumination and that the lamps receive pretty rough usage, being cleaned three times a week.

North Carolina Independent Telephone Association.

At the third annual meeting of the North Carolina Independent Telephone Association, which was held recently at High Point, N. C., the following officers were elected: President, W. A. Wynne, Raleigh; vice-president, H. P. Grier, Statesville; secretary and treasurer, B. W. Levitt, Southern Pines. Executive committee: W. A. Wynne; J. B. Morris, Roxboro; H. P. Grier; H. P. Stephenson, Smithfield, and J. F. Hoyden, High Point.

Tube Lighting.

By D. McFarlan Moore.

THAT vacuum-tube lighting is advancing steadily is evidenced by the fact that the United States Government has again placed a large order with the Moore Electrical Company for additional apparatus. The order comprises 3,192 feet of one-and-three-quarter-inch lighting tube in twenty-eight sections. Each section of 114 feet will operate from its individual terminal box containing the transformer and regulating apparatus. It will be remembered that a perfect vacuum, if obtainable, would be the best insulator known, and therefore all so-called vacuum tubes must contain enough residual air or other gas to conduct the electricity, which produces the light, through them. About one ten-thousandths as much gas remains in a Moore tube as would be present if the vacuum pump had not been applied. Also, this one ten-thousandths must not vary either way more than one one-hundred-thousandths in order that the light in a vacuum tube remain at a constant intensity and also in order that the light may continue more than several minutes. In other words, to be practical the tube must be fed extremely minute particles of air or other gases at intervals of every few minutes. This is the function of the simple, though sensitive, automatic feed-valve within the terminal box.

When this valve is supplied with ordinary air a pink-colored light results, but if the oxygen of the air is automatically removed by simply causing the air intake to first pass through a bottle containing phosphorous, the gas which passes on to the feed-valve is practically pure nitrogen, which changes the color of the light to a golden yellow that resembles sunlight. It not only produces about thirty per cent more light, but has many other advantages over ordinary air and is, I believe, the most efficient form of light known for illuminating comparatively large areas. Some of the Moore tubes above referred to, which are about to be installed in the New York Post-Office, will be in the form of loops, that is, tubes, the ends of which return upon themselves and some in the form of perfectly straight single tubes, each one and three-quarter inches in diameter and 114 feet long.

Several months ago three new-style Moore tubes were installed in the New York Post-Office. Two of them are shown in Fig. 1. Heretofore Moore tubes have been installed in almost any length and shape, but it has been found very advantageous to decide on certain definite units. These three new tubes are in the forms of large hairpins—that is, the tubing extends fifty-seven feet from a terminal box and then returns upon itself, the two legs being only six inches apart. The total length of the entire light-giving tube is therefore 114 feet. It will be noticed that these units are held within a few inches of the ceiling by simple cast-iron fixtures placed every eight feet, and that they also support mirrored glass reflectors directly over the two legs of these tubes.

Fig. 2 shows the first Moore tube equipped with a corrugated mirrored-glass Frink reflector. Altogether such a combination makes a lighting device that

FIG. 1.—MOORE TUBE WITH FRINK REFLECTOR IN REGISTRY DIVISION, NEW YORK CITY POST-OFFICE.

FIG. 3.—MOORE HAIRPIN UNITS IN THE COLOR-MATCHING DEPARTMENT OF THE WEIDMANN SILK MILLS.

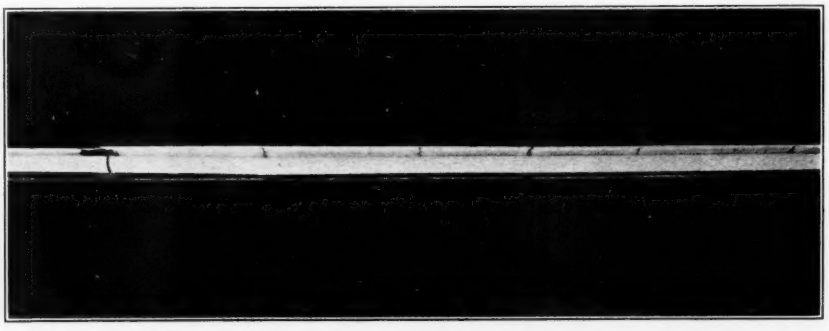


FIG. 2.—MOORE TUBE WITH FRINK REFLECTOR INSTALLED IN REGISTRY DIVISION, NEW YORK CITY POST-OFFICE.

lends itself with great facility to the solution of all illumination problems involving comparatively large areas. These new standard units are designed to operate on 220 volts, sixty cycles. They consume 2,400 watts and produce a distributed illumination of about 1,300 Hefners that is almost ideal. The ceiling is thirteen feet seven inches high, but with the two hairpin units in operation over the area shown there results an intensity of about nine Hefner feet on the tables used for sorting and distributing the mail. Due to the great responsibility involved in handling registered mail, it is important that a system of lighting be used that will permit all employés to be easily and clearly distinguished over long distances.

During the past few months the various claims for the Moore light have been amply corroborated by numerous investigations, tests and reports by thoroughly disinterested parties. As time passes the fact is emphasized that the fundamental principles of vacuum-tube lighting are correct and are in direct line with the tendency of the development in all classes of illuminating devices.

As regards maintenance charges, with its extremely long life, the vacuum tube will produce an illumination that is so well diffused that its illuminating efficiency is really better than is represented by five candle-power-hours for one cent, or about 0.25 watt per square foot of floor area for each foot-candle.

The determining of the best kind of gaseous conductors for vacuum tubes represents almost a virgin field of large dimensions, the discoveries in which will soon be of vital importance to the whole lighting industry. For example, helium gas offers large possibilities, but so far as color values are concerned it is very doubtful whether any form of gas will ever be obtained which will more closely imitate average natural diffused daylight than does carbon-dioxide in an automatically fed vacuum tube. It should be, and I firmly believe will be, adopted as the standard of light both as regards intensity and color. In fact, at the present time all other forms of light, so far as their color values are concerned, should be expressed in terms of the carbon-dioxide vacuum tube.

Fig. 3 shows one of the largest silk dyers in the world, Jacob Weidmann, in the color matching room of his large works at Paterson, N. J. It is well known that hardly any business requires more accurate color determinations than that of dyeing silk, yet it has been found by over a year's severe tests that in one respect matching colors under the Moore tubes is preferable even to diffused daylight, because the light of the tubes is always the same, while natural light varies widely under different atmospheric conditions and at different hours of the day, different months of the year, etc. The remarkable color values of the carbon-dioxide tube have proven valuable also in photography, where skylights have been equipped on their under sides with the tubes in a somewhat similar manner, so that, so far as the photographer's business is concerned, practically no difference exists between daytime and night-time.

The Moore vacuum tubes are aiding all the new forms of efficient lights in proving to central stations and other interested parties the at first seeming paradox that the cheaper the operating expense as regards current the greater their business will finally be due to the resulting increase in the quantity of light used.

Some Recent Developments in Arc-Lamp Construction.

By Dwight D. Miller.

PROFESSOR ANDREWS has said in his admirable paper on long flame arc lamps that "it is interesting to note that all the marked improvements made in arc lighting within recent years have been effected by using arcs of from ten to fifteen millimetres in length, and investigation shows that the great improvement in efficiency is directly or indirectly due to this increased length."

These new lamps can be arranged in two distinct classes: (1) Those arranged with inclined carbon rods and (2) those arranged with vertical or coaxial carbon rods as in the ordinary enclosed arc lamps. To the first class belong the "Polar" flaming arc lamp and the "Carbone" lamp, while the "Radiante" and "Radiante Economy" lamps belong to the second class.

As stated above, the "Polar" flaming arc lamp is arranged with inclined carbon rods which are secured in metal holders and slide down substantial guide rods converging at a point immediately below the economizer within the globe. Only one globe is used. The whole appearance of the lamp is very pleasing and attractive. The case is sheet steel and ordinarily furnished in black finish. The carbon holders are of ample strength and size to prevent heating. The lamp works on the differential principle—that is, the feeding mechanism is actuated by the resultant pull of a series and shunt magnet working at right angles to each other. This principle of operation insures a sensitive, nice and accurate feed of the carbons, resulting in a reliable and steady-burning arc. This feeding mechanism is absolutely shut off from the main body of the lamp; contained in a separate weather and dustproof case, provided with a rubber gasket and sealed before sending out. The guide rods, carbon holders and rods are below the feeding mechanism in the main body of the lamp, and are readily accessible for trimming by simply lowering the case by means of thumb hooks provided therefor.

The arc itself burns in the economizer, which takes the place of the inner globe in an ordinary enclosed arc lamp. This economizer is composed of highly refractory material, cup-shaped and deeply recessed. The effect of this economizer is (1) a concentration of the heat of the arc, producing thereby a greater intensity of light; (2) prevention of an excess of oxygen reaching the arc, which means longer life to the carbons; (3) as the carbons burn, a pure white metallic oxide is deposited in the inside of the economizer which is an excellent reflector, increasing the diffusion of light, and (4) protection of the arc from drafts. This protection is further supplemented by furnishing glass wind shields which project below the economizer and increase the burning hours ten per cent.

This type of lamp requires but forty-two volts at the arc with a current consumption of ten amperes—producing upwards of 3,000 candle-power. They burn most economically two in series on 110-volt and four in series on 220-volt circuits, with a consumption of 550 line watts per lamp.

Carbons cored with different metal salts are used, giving either a rich golden or brilliant white light as desired.

Too much stress can not be laid upon the substantial construction and reliable operation of these lamps. They burn

steadily and uninterruptedly during the entire length of life of the carbons, and automatically cut themselves out when the carbons have burned their full time. Many thousands are in daily use and have been for several years past. In fact, ninety-five per cent of the exterior lighting in Berlin, Germany, is by means of the long-flame arc lamp.

The "Polar" flaming arc lamp is handled in this country in two sizes. One, known as the short type, two feet eight inches long over all, takes a carbon 400 millimetres in length, burns twelve hours

"Polar" Flaming Arc Lamp.

on one trim and weighs twenty-six and one-half pounds, while the long-type lamp is three feet six inches over all, taking a carbon 650 millimetres long, burns twenty hours on one trim and weighs thirty-three pounds. The lamp burns equally well when connected in multiple and on any circuit.

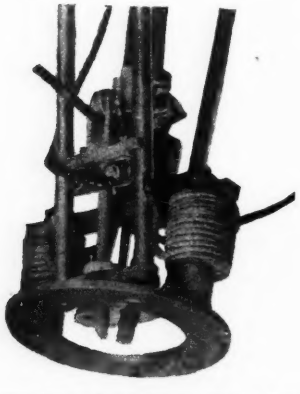
It is interesting to note that a very successful test of this lamp has been completed at one of the largest power-houses in New York city, burning three in series on a 200-volt, twenty-five-cycle alternating-current circuit. The test lasted through a period of three weeks, during which time the lamp demonstrated beyond the question of a doubt its stability on such a circuit.

We come now to the second lamp in Class 1, namely, the "Carbone" lamp. Here again we have a lamp working on the differential principle with inclined carbons converging at a point within the economizer in the globe. In outward appearance the "Carbone" lamp is very similar to that of the "Polar" flaming arc lamp, the standard finish of case and the special shaped "Pilz" globe, a patented article, being the same in both cases.

By the use of pure carbon rods all fumes and gases are avoided and we obtain what is the most striking feature of this lamp, namely, its light, which is pure white, of great brilliancy and purity, and absolutely steady.

"Carbone" Lamp with Mushroom Globe.

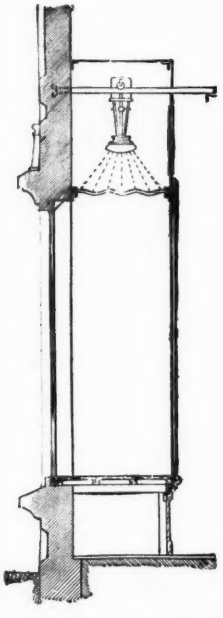
The "Carbone" lamp works on a high arc voltage—eighty-five volts for the direct-current and seventy volts for the alternating-current lamp—so that it burns in multiple on 110 to 120-volt and two in



Magnetic-Ring Control of the "Carbone" Lamp.

series on 220 to 240-volt circuits. The effect of this high voltage is that the crater of the arc forms on the very end of the carbon tips and is held fixed there by a very ingenious device, patented by Mr. Carbone, known as magnetic-ring control. This consists of a closed metallic circuit in the form of a ring, concentric with and placed just above the economizer of the lamp. On this ring are mounted two solenoids with a soft iron bar connected across the tops, and the position of the arc is rigidly controlled by the magnetic leakage from this closed circuit. Naturally, the leakage is greatest where the solenoid cores enter the ring, and this is further increased by boring holes in the ring itself in such a manner that the field produced by this leakage holds the arc in the desired position, spreading it out in a semicircular, shadowless and steady flame.

The efficiency of this lamp is very high, taking but 0.6 of a watt per candle-power, and producing 1,350 candle-power of pure white light with a consumption



Cross-Section of Show-Window, Showing Method of Concealing Light.

of only eight amperes. It is handled in two sizes of approximately the same dimensions and weight, as in the case of the "Polar" flaming arc lamp, the short type burning eleven hours and the long type sixteen hours. This lamp also burns on twenty-five to 150 cycles, alternating current.

The science of illumination requires that not only shall there be the proper quantity and quality of light, but also, what is more essential, that this light shall be correctly diffused. By means of various types of shades, globes and reflectors, direct, semi-direct or indirect illumination can be produced, according to the specific requirements of the particular problem under consideration. By using the special-shaped "Pilz" globe the distribution of light becomes exceedingly uniform. Again, by using special shapes and shades of glass and opaque reflectors the light is thrown in various directions and reflected back to

the eye much softened and properly diffused. All shadows are also eliminated.

We now come to the second class of lamps, with coaxial carbon rods. This construction is found in the "Radiante" and "Radiante Economy" lamps. These lamps are a direct outgrowth of the "Carbone" lamp, and put upon the market to meet the demand for a longer-life lamp. Thus they combine the pure white, steady, daylight effect of the "Carbone" lamp with long life and efficiency.

Here again pure carbon rods are used with soft cored centres. The rods are arranged vertically one over the other as in the well-known enclosed-arc construction but provision is made for lengthening the arc, thus eliminating all shadows from the lower carbon. The lower carbon is stationary and the upper feeds down as it burns away. The proper trimming height of the lower carbon is marked by a notch in the lower carbon holder which is centered accurately with the upper holder ensuring perfect alignment of carbon rods and an even, steady and economical burning of the carbons. The feeding mechanism is of simple construction, consisting of a magnet working against gravity. This control is positive in its action, accurate and nice in its adjustment, which results in a steady arc. The arc is only partially enclosed, the object being to obtain long life of carbons and yet avoid the disadvantages of the completely enclosed arcs, such as bluish color and unsteadiness of flame. The lamps are very attractive and pleasing in appearance, the same material and standard finish of case and "Pilz" globe being used as in the case of the "Polar" flaming arc and "Carbone" lamps.

The efficiency is again very high as the lamp takes but 0.5 of a watt per candle-power.

These lamps also burn with a high-voltage arc, requiring eighty volts, and at present are designed to burn on direct-current circuits only, in multiple on 110 to 120 volts, and two in series on 220 to 240 volts; but an alternating-current lamp of this type is promised by the manufacturers in a short time. They are made in two sizes: The "Radiante," two feet seven and one-half inches long over all, takes a carbon 400 millimetres in length, burns fifty hours on one trim, and weighs eighteen pounds, and the smaller type, known as the "Radiante Economy" lamp is twenty-one inches over all, takes a carbon 300 millimetres in length, burns thirty-two hours on one trim, and weighs nine pounds.

The "Radiante," with a consumption of eight amperes, gives a light of 1,200 candle-power, and the "Radiante Economy," with four amperes, gives 600 candle-power of pure white, steady light.

As in the case of the "Carbone" lamp different degrees and types of illumination can be obtained to meet specific requirements, by using the same kind of shades, globes and reflectors. In the case of the "Radiante Economy" lamp a milk glass reflector is provided in addition. The field of these lamps is almost unlimited, but they are especially recommended for lighting interiors where the highest grade of lighting is essential and desired, and true color reproduction necessary.

No hard and fast rules can be laid down as to which type of illumination should be used, and each case should and must necessarily be considered according to its specific requirements and the effect it is desired to obtain, but it is obvious that where the ceilings are high or strong light necessary, as for instance, where black threads and material are treated, direct illumination is the logical choice. While, on the other hand, in rooms with low ceilings or where no shadows are desired, semi-direct or indirect lighting would give the better effect.

A very novel, as well as effective and economical, method of lighting show windows, known as "Standard Show Window Illumination," in connection with the "Carbone," "Radiante" and "Radiante Economy" lamps, has just been introduced in this country. It seems that the majority of merchants have been and are laboring under the fallacy that the more and stronger light they have the better the customers can see the goods displayed, overlooking entirely that very vital point of diffusion. This fallacy becomes at once apparent if, on a perfectly clear summer day, one goes out at noontime, when the sun is directly overhead and its light least diffused by atmospheric conditions, and tries to look directly at it. The effect is blinding. Yet here is the strongest and best type of light known, but the difficulty is there is no diffusion. The object of show-window illumination is to attract passersby and cause them to look at the goods therein displayed. This is done most effectively when the source of light is entirely concealed, because then the whole attention can be concentrated on the contents of the window and the eye left entirely free from any glare. The illustration herewith gives a cross section of a show window showing this method of concealing the light and how the desired effect is obtained. The lamps are arranged high up in the window and entirely shut off from the gaze of the onlooker by heavy fluted glass, while the light itself is diffused and the window illuminated with a pure white light, bringing out the color values of the goods accurately.

These lamps are the product of the Carbone Light Gesellschaft, of Berlin, Germany, and are handled exclusively in the United States and Canada by the electrical department of Fox Brothers & Company, 126-130 Lafayette street, New York city.

THE KUZEL LAMP.

BY PAUL M'JUNKIN.

The Kuzel lamp continues to make substantial progress, and although it is not yet manufactured in this country, negotiations are progressing toward that end. In the meantime increasing quantities are being imported, as the European manufacturers are able to spare lamps for this market.

This lamp has been the standard in Europe for some months, and burns in any position. The standard candle-power is twenty American candles, twenty-five watts, for the 110-volt lamp. This type of lamp is made almost to the entire exclusion of the higher candle-powers.

The lamp is rugged physically, which is due partly to the ingenious anchoring employed, but principally to the superior quality of the filament itself. The colloidal process employed by Dr. Kuzel produces a filament of perfect homogeneity and great elasticity, as well as purity.

The lamps at present are made in bulbs of practically equivalent sizes to those used for carbon lamps of corresponding candle-powers, and are fitted with the same style of base as is used on all low-candle-power carbon-filament lamps.

The Kuzel lamps are now manufactured in Austria, Germany, Sweden and Great Britain, and the solidarity of the business is typified by the new factory which has been erected in Vienna. This factory, which is being operated by Kremenezky, has a present capacity of 25,000 lamps per day. Every precaution has been made to increase the plant and equipment to 60,000 lamps per day as rapidly as it may be necessary. Kremenezky has been recognized for years as the leader in high-class carbon-lamp manufacture in Europe, and he has naturally devoted his best energies to the equipping of the new tungsten-lamp factory with the most perfect machinery that has been developed for tungsten-lamp manufacture up to the present time.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

TWIN CITY RAPID TRANSIT COMPANY.

The report of the Twin City Rapid Transit Company, Minneapolis, Minn., for the month of July and seven months ended July 31, shows July gross of $606,373; expenses, $278,138; July net, $328,235; charges, taxes and preferred dividend, $128,361; July surplus, $199,874. Seven months' gross, $3,589,222; expenses, $1,813,728; seven months' net, $1,775,494; charges, taxes and preferred dividends, $877,788; seven months' surplus, $897,706.

UNITED STATES TELEPHONE COMPANY.

The annual report of the United States Telephone Company, of Cleveland, Ohio, for the year ended December 31, 1907, shows gross of $435,013; expenses and taxes, $184,135; net, $250,878; other income, $34,965; total income, $285,843; charges, $116,877; balance, $168,966; preferred dividends, $51,150; balance, $117,816; common dividends, $69,750; surplus, $48,066.

UNITED RAILWAYS COMPANY.

The report of the United Railways Company, of St. Louis, Mo., for the month of July and seven months ended July 31, shows July gross of $898,210; expenses, $578,528; July net, $319,682; charges, $232,852; July surplus, $86,830. Seven months' gross, $6,061,765; expenses, $3,946,037; seven months' net, $2,115,728; charges, $1,618,399; seven months' surplus, $497,329.

NEW ORLEANS RAILWAY AND LIGHT.

The report of the New Orleans (La.) Railway and Light Company and controlled companies for the six months ended June 30 shows gross of $3,054,535; expenses, $1,714,429; net, $1,340,106; charges, $991,521; surplus, $348,585; other deductions, $27,144; balance, $321,441. Of the balance there is to be reserved $23,338 for rehabilitation of tracks and cars and other equipment.

CUYAHOGA TELEPHONE COMPANY.

The annual report of the Cuyahoga Telephone Company, of Cleveland, Ohio, for the year ended December 31, 1907, shows gross of $781,586; expenses and taxes, $346,913; net, $434,673; charges, $207,458; surplus, $227,215; dividends, $131,222; net surplus, $95,993.

CUMBERLAND TELEPHONE AND TELEGRAPH COMPANY.

The report of the Cumberland Telephone and Telegraph Company for the month of July and seven months ended July 31 shows July gross of $500,094; expenses, $283,473; July net, $216,621; charges and taxes, $37,347; July surplus, $179,274. Seven months' gross, $3,557,072; expenses, $2,065,681; seven months' net; $1,491,391; charges and taxes, $260,357; seven months' surplus, $1,231,034.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY.

The report of the American Telephone and Telegraph Company for the first seven months of 1908 shows gross earnings of $15,097,966; expenses, $1,223,807; net earnings, $13,874,161; interest, $4,026,937; balance, $9,847,223; dividends, April and July, $5,262,056; surplus, $4,585,168.

WESTCHESTER ELECTRIC RAILROAD COMPANY.

The report of the Westchester (N. Y.) Electric Railroad Company for the quarter ended June 30 shows gross of $97,747; expenses, $104,102; deficit, $6,355; other income, $137; deficit, $6,218; charges, $3,819; total deficit, $10,037.

MONTREAL STREET RAILWAY COMPANY.

The report of the Montreal Street Railway Company for the month of July and ten months ended July 31 shows July gross of $326,524; expenses, $162,413; July net, $164,111; charges, $65,012; July surplus, $99,098. Ten months' gross, $2,999,187; expenses, $1,814,428; ten months' net, $1,184,159; charges, $515,888; ten months' surplus, $668,971.

SEATTLE ELECTRIC COMPANY.

The report of the Seattle Electric Company, Seattle, Wash., for the month of June and twelve months ended June 30 shows June gross of $358,207; expenses, $202,875; June net, $155,332; charges, taxes and sinking fund, $93,695; June surplus, $61,637. Twelve months' gross, $4,384,438; expenses, $2,594,122; twelve months' net, $1,790,316; charges, taxes and sinking fund, $1,017,674; twelve months' surplus, $772,642.

GALVESTON-HOUSTON ELECTRIC COMPANY.

The report of the Galveston-Houston (Tex.) Electric Company for the month of June and twelve months ended June 30 shows June gross of $92,442; expenses, $53,235; June net, $39,207; charges, taxes and sinking fund, $21,009; June surplus, $18,198. Twelve months' gross, $1,069,016; expenses, $625,598; twelve months' net, $443,418; charges, $237,977; twelve months' surplus, $205,441.

MINNEAPOLIS GENERAL ELECTRIC COMPANY.

The report of the Minneapolis (Minn.) General Electric Company for the month of June and twelve months ended June 30 shows June gross of $70,766; expenses, $31,838; June net, $38,928; charges, taxes, $31,507; June surplus, $7,421. Twelve months' gross, $955,510; expenses, $434,040; twelve months' net, $520,670; charges, $348,021; twelve months' surplus, $172,649.

BUFFALO & LAKE ERIE TRACTION COMPANY.

The report of the Buffalo & Lake Erie Traction Company for the quarter ended June 30 shows gross of $134,656; expenses, $91,937; net, $42,719; other income, $5; total income, $42,724; charges, $95,640; deficit, $52,916.

INTERBOROUGH RAPID TRANSIT COMPANY.

The report of the Interborough Rapid Transit Company, New York city, for the quarter and twelve months ended June 30 shows gross earnings for the quarter of $6,248,224; operating expenses, $2,796,102; net earnings, $3,452,142; other income, $305,307; total income, $3,757,449; interest and taxes, $847,622; rentals, $2,025,485; total charges, $2,873,107; surplus, $884,342. For the fiscal year the gross earnings were $24,059,290; operating expenses, $10,722,695; net earnings, $13,336,604; other income, $1,220,170; total income, $14,556,074; charges, $10,856,116; surplus, $3,700,658.

NORTHERN OHIO TRACTION AND LIGHT COMPANY.

The report of the Northern Ohio Traction and Light Company for July and seven months shows July gross of $200,392; expenses, $105,377; July net, $95,015; charges, $44,052; July surplus, $50,963. Seven months' gross, $1,039,134; expenses, $624,037; seven months' net, $415,097; charges, $305,212; seven months' surplus, $109,885.

SCHENECTADY RAILWAY COMPANY.

The report of the Schenectady (N. Y.) Railway Company for the quarter ended June 30 shows gross of $220,110; expenses, $158,559; net, $61,551; other income, $916; total income, $62,467; charges, $30,883; surplus, $31,584.

BIRMINGHAM RAILWAY, LIGHT AND POWER COMPANY.

The report of the Birmingham (Ala.) Railway, Light and Power Company for the month of July and seven months ended July 31 shows July gross of $170,-

777; expenses and taxes, $113,425; July net, $57,352; charges and sinking fund, $44,075; July surplus, $13,277. Seven months' gross, $1,235,602; expenses and taxes, $796,202; seven months' net, $439,400; charges and sinking fund, $307,370; seven months' surplus, $132,030.

MEMPHIS STREET RAILWAY COMPANY.

The report of the Memphis (Tenn.) Street Railway Company for the month of July and seven months ended July 31 shows July gross of $140,461; expenses and taxes, $89,017; July net, $51,444; charges, $35,465; balance, $15,979; reserve funds, $2,500; July balance, $13,479. Seven months' gross, $915,529; expenses and taxes, $583,418; seven months' net, $332,111; charges, $243,905; balance, $88,206; reserve funds, $17,500; seven months' surplus, $70,706.

DETROIT UNITED RAILWAY COMPANY.

The report of the Detroit (Mich.) United Railway Company for July and the seven months ended July 31 shows July gross of $679,447; expenses and taxes, $417,869; July net, $261,577; other income, $6,462; total income, $268,039; charges, $135,978; July surplus, $132,061. Seven months' gross, $3,964,875; expenses and taxes, $2,528,176; seven months' net, $1,436,698; other income, $35,072; total income, $1,471,770; charges, $948,952; seven months' surplus, $522,818.

TOLEDO RAILWAYS AND LIGHT COMPANY.

The report of the Toledo (Ohio) Railways and Light Company for July and seven months shows July gross of $199,237; expenses, $111,665; July net, $87,572; other income, $91; total income, $87,663; charges and taxes, $71,751; July surplus, $15,912. Seven months' gross, $1,429,612; expenses, $794,054; seven months' net, $635,558; other income, $2,874; total income, $638,432; charges and taxes, $491,887; seven months' surplus, $146,545.

KNOXVILLE RAILWAY AND LIGHT COMPANY.

The report of the Knoxville (Tenn.) Railway and Light Company for July and seven months ended July 31 shows July gross of $51,720; expenses and taxes, $26,330; July net, $25,390; charges, $11,483; balance, $13,907. Seven months' gross, $323,820; expenses and taxes, $171,027; seven months' net, $152,792; charges, $80,160; seven months' surplus, $72,632.

NASHVILLE RAILWAY AND LIGHT COMPANY.

The report of the Nashville Railway and Light Company, Nashville, Tenn., for the month of July and seven months ended July 31, shows July gross of $127,936; expenses and taxes, $78,215; July net, $49,721; charges, $33,101; balance, $16,620; reserve funds, $3,858; July surplus, $12,762. Seven months' gross, $887,986; expenses and taxes, $542,399; seven months' net, $345,587; charges, $221,162; balance, $124,425; reserve funds, $26,528; seven months' surplus, $97,897.

LITTLE ROCK RAILWAY AND ELECTRIC COMPANY.

The report of the Little Rock (Ark.) Railway and Electric Company for July and seven months ended July 31 shows July gross of $53,560; expenses and taxes, $30,095; July net, $23,465; charges and sinking fund, $10,874; surplus, $12,591; reserve funds, $3,000. Seven months' gross, $364,293; expenses and taxes, $198,717; charges and sinking fund, $68,875; reserve funds, $21,000; seven months' surplus, $95,701.

BOSTON ELEVATED RAILWAY COMPANY.

The report of the Boston Elevated Railway Company for August shows an improvement over the results for July. Figures for the last four months compare as follows: May, $1,214,000; June, $1,224,000; July, $1,158,000; August, $1,133,000. While the receipts show a comparative decline in gross for two successive months, the actual decrease in gross receipts for August was $37,000, a loss of 3.1 per cent, which compares with a July decline of $76,000, or 6.1 per cent.

Canadian Independent Telephone Association.

The third annual convention of the Canadian Independent Telephone Association was held in Toronto, Ontario, on September 9. The following papers were presented at the meeting: "Bell Connections," Dr. W. Doan; "Independent Telephones at Railway Stations," C. Skinner; "Mutual *versus* Joint Stock Companies," A. R. Walsh; "Rural Line Equipment and the Best Way to Serve the Farmers," F. A. Dales; "Rates to Be Charged and the Best Form of Collecting," A. Hoover; "To What Extent Should Free Service Be Given?" A. D. Bruce; "Division of Territory Between Telephone Companies," Levi Moyer; "Toll Line Connections: How Best Effected," Alex Neilson and Henry Sneath; "Western Situation and Its Future," F. Dagger; "Our Interests in Towns and Cities," M. Gee; "The Independent Movement in Towns and Rural Communities," T. R. Mayberry, M.L.A.; "Exclusive Franchises and Government Regulation," Dr. A. Ochs.

BOOK REVIEW.

"Wissen and Können." Dr. Richard Henning. Johann Ambrosius Barth, Leipzig, Germany. Boards. 199 pages. 6 x 9 inches. 61 illustrations. Price 4 marks ($1.25).

This is the eighth volume of a series of books ("Knowledge and Ability") published at regular intervals, by different authorities, on pure and applied science, and gives the history and development of telegraphy and telephony. The author goes back to ancient times and shows how the old Greeks were eager to develop means for a speedy transmission of intelligence to which the term telegraph fitly applied; starting with a wigwagging of hands and flags and the building of bonfires. A further development was the erection of signal towers of the most primitive type. With the advent and development of electricity came vast possibilities. The various types of magneto-electric and chemical-electrical telegraphs are described, up to and including the Morse telegraph and cipher code. The modern telephone and cable telegraph are described and illustrated, wireless telegraphy, however, not being mentioned.

Probably the most interesting feature of the work is the statement of the opinions of the inventors of the various instruments and devices at the time of their invention.

The volume is written in a clear and forcible manner and should appeal not only to the engineer but to the every-day reader.

The Buckeye Electric Company Conference.

The Buckeye Electric Company, Cleveland, Ohio, during the week of August 29 held its most successful annual conference. During the week there were in attendance fifteen direct branch managers and salesmen of the company, as well as about ten guests. Everything in connection with the incandescent-lamp business was discussed very thoroughly, especial attention being devoted to the discussion of the newer types of lamps. The company is confident that this meeting will bring excellent results, both to itself and its customers.

The company is starting the season in better shape this year than it ever did before, and in substantiation of this makes the statement that its business for August, 1908, is at least twenty per cent greater than it was for August, 1907.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

Just-Wolfram Lamps for 220 Volts.

To overcome the difficulties which have appeared in the manufacture of long metal filaments of small cross-section, and to turn out serviceable metal filaments for forty watts at 220 volts, for commercial purposes, the Physikalisch Technische Reichsanstalt, at the request of the Wolfram Company, made extensive tests with fifty-watt lamps operating at 220 volts. The tests proved that the intensity of light between the high and low-voltage lamps varied but little, and the durability and life of the lamps were the same. The test of the Reichsanstalt consisted of burning twelve lamps for 1,600 hours each on direct current. The results showed that the average life of the lamps was 1,141 hours. Up to 1,400 hours the average intensity of the light remained the same and the specific current consumption increased 1.5 per cent, being 1.23 watts per candle (Hefner). A test at the factory on alternating current gave, after 1,000 hours, 1.25 watts per candle (Hefner), with an average life of 1,224 hours.—*Translated and abstracted from the Journal für Gasbeleuchtung und Wasserversorgung (Munich), August* 8.

The Transmutation of Copper.

Sir William Ramsay and A. T. Cameron announced, about a year ago, that they had observed the production of the alkaline metals and lithium in solutions of copper salts submitted to the action of radium emanation. It was concluded that in the presence of the emanation, copper underwent a degradation into the elements, potassium, sodium and lithium. A recent issue of *Comptes Rendus* of the Paris Academy of Sciences contains an article by Mme. Curie and Mlle. Gleditsch, giving an account of the attempts that they have made to repeat this experiment. The extreme difficulty of obtaining chemical products free from lithium is pointed out. This metal was found in distilled water and in nearly all the reagents. If a reagent free from lithium is allowed to stand in a glass vessel, traces of this metal are found after some time. Both opaque and transparent quartz were found to contain notable amounts, the latter furnishing the larger proportion. The experiments were carried out in such a manner that the solutions came in contact with platinum only. The water and acids necessary for the experiment were redistilled from platinum and preserved in platinum bottles. After this treatment no lithium could be detected in the residue from twenty-five cubic centimetres of nitric acid, twenty-five cubic centimetres of hydrofluoric acid, and 250 cubic centimetres of water. About the same quantities of copper and radium emanation as those used in the original experiment were employed. Spectroscopic examination of the salt residue obtained showed it to consist of salts of sodium with a little potassium. The presence of lithium could not be proved. The authors conclude that they have been unable to confirm the experiments of Messrs. Ramsay and Cameron.—*Abstracted from Nature (London), August* 20.

The Lucerne-Engelberg Hydroelectric Transmission System, Switzerland.

For supplying current to the city of Lucerne and vicinity, the water of a natural collecting basin, of 2,471,000 cubic feet capacity, fed by streams and glaciers of the Engelberg, is utilized at a power plant at Obermatt, about seventeen miles from Lucerne. Current is transmitted at 27,000 volts. The turbines, of which four are at present installed, are of the impulse type, operating under a head of 1,023 feet. They are connected to 2,000-horse-power, fifty-cycle, 6,000-volt generators, making 300 revolutions per minute. These generators have a capacity of 1,850 kilovolt-amperes, three-phase, or 1,380 kilovolt-amperes, single-phase. This plant also contains one reserve unit for the Stanstad-Engelberg railway system. This is an impulse turbine coupled to a 540-kilovolt-ampere, 780-volt, 32.5-cycle, three-phase generator, which has a bus-bar system of its own. The current from the main generator is stepped up by 700-kilovolt-ampere single-phase transformers to 27,000 volts. On each side of the transformers are two separate ring bus-bar systems, one for single-phase (light), and the other for three-phase (power). All the transformers are single-phase. There are three transformers for single-phase light supply and two groups of three single-phase transformers, connected in delta, for power service. Between the power transformer groups is one single-phase transformer which serves as a reserve unit for both groups. The transformers are of the oil, water-cooled type. If the water supply falls below the normal an automatic electric signal system gives notice of this condition. The aerial conductors are carried on lattice-steel towers. A feature of the construction is the cantilever arrangement of supporting them above the shores of Vierwaldstaetter Lake. There are several transformer stations along the line which step the line voltage down to 5,000 and 350 volts for local distribution. The whole system is well protected by lightning arresters among which is the combination of the horn lightning arrester and water-flow grounder, a system much favored in Continental practice.—*Translated and abstracted from the Elektrotechnische Zeitschrift (Berlin), August* 6.

The Use and Conservation of Water-Power Resources.

H. von Schon, the author of the present article, holds that water power is the expression of the dynamic energy of falling water, eighty per cent of which may be realized as mechanical energy, and seventy per cent as electrical energy. Theoretically, all the fall and flow of a river is available for power development, but the practical limit is a question of economics. Successive dams may be placed so that the lower pool of one becomes the upper of the next, but this may prove, in cases, wasteful in cost, as economic dam sites are not always arranged by nature with such regularity. The volume of available flow is as important a factor as the fall, as the product of fall and weight of volume represents the source of water-power energy. Without the consideration of flood-flow storage the determination of available flow basis should be developed

from a consideration of the market demand, and the value of the output, in order to decide how large an investment in auxiliary power plant or electric storage equipment the enterprise will stand; and the capacity of this, added to the low-flow output, will point to the volume which may be accepted as the available flow. As far as accurate data are concerned, we find ourselves in the position of the man who has done business without keeping books. For some time to come we can not take an inventory of our water-power asset. It appears that from data collected by the author, the undeveloped water power of New England, New York, Pennsylvania, the middle and southern states, and the Pacific coast watershed, sums up to a grand total of 10,000,000 horse-power, based on the unconserved flow. A reasonable estimate of our available water-power assets appears to be about 20,000,000 horse-power, representing the annual equivalent in steam fuel of about 300,000,000 tons. At $100 per horse-power this would require an investment in water-power works of approximately $2,000,000,000, and a further investment in hydraulic and power-generating equipment, at $50 per horse-power, of $1,000,000,000. At a valuation of $35 per horse-power per annum—about 0.75 cent per kilowatt-hour—for continuous service, the income at three per cent represents a total earning on about $20,000,000,000. Results which will conserve the entire benefits of the water-power resources, and render this conservation economical and profitable, can be realized only by the combined resources and powers of the whole people. The investigations of flood-storage opportunities should be carried on by the state. If storage of flood waters were determined to be feasible, a state commission should have authority to designate the reservoir sites as a state water and forest reserve, and acquire title by condemnation to sufficient land to control the reservoir feeders. They should then lease the same to the lowest bidder for the construction of the necessary storage works and their maintenance and operation, fixing the amount of tolls at a certain per cent on the investment for land and works, which should be covered by a state bond issue. The power development works should be exempt from taxation for a period of years, during which the principal of the capital investment remains a charge against them, conditioned upon a specified programme of serial retirement of the securities and of their total redemption. The water-power company should be chartered by the state, the latter reserving the right to periodical inspection of its works and of regulation of the rates charged for the product. Finally, the Federal Government, upon the request of the state, should examine the feasibility of creating navigation on the stream, its extent and cost; and if the findings are satisfactory, a proper navigation lock should be constructed with each power development dam, under the supervision of the government, and the cost thereof and of buildings and appurtenant navigation locks should be defrayed by the United States Treasury, as well as the expense of any canalization or deepening of channels between such power sites. This would secure the co-operation of individual enterprise, and of the powers of the community, state and nation, toward the object of conserving the water and all its collateral assets, thereby placing within the reach of every community hydroelectric power products.—*Abstracted from the Engineering Magazine (New York), September.*

Illumination and Our Eyesight.

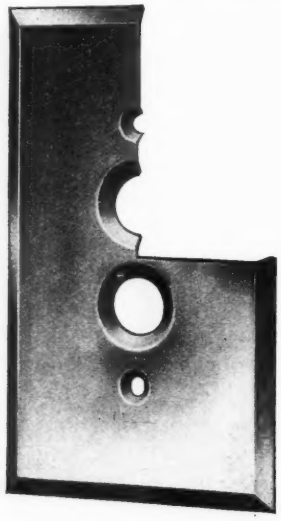
The introduction of powerful electric incandescent lamps fitted with metallic filaments has increased the complaints of the deleterious effect upon the eyesight of the high illumination which is being adopted in many places where artificial light is employed. Lamp manufacturers are anxious to meet the objections, and the question came up recently at the annual meeting of the German electrical engineers, the Verbund Deutscher Electrotechniker. In a paper by F. Schanz, M.D., and Dr. C. Stockhausen it is pointed out that the ultra-violet rays are a source of danger, and that with the improvement of our lamps we have been receiving more and more ultra-violet rays. The spectrum of the light of a paraffine or wax candle and of an ordinary rape-seed oil wick is hardly longer than that of the visible rays. When the combustion is rendered more energetic by the aid of a chimney, the ultra-violet rays increase. In the incandescent gas light, in the electric and Nernst lamps, and particularly in the mercury arc, ultra-violet rays abound. These conditions are masked to a certain extent when we surround the sources of light with glass shades, for the glass absorbs a good many rays; but ultra-violet rays find their way through ordinary glass. That ultra-violet rays, especially of very small wave-length, set up irritation of the skin, is sufficiently known from extended observation and special experiments. These rays cause injury and seem also to cure diseases under certain conditions. At any rate, they are active. Rays of greater wave-lengths are less directly injurious. Some physicians, like Dr. Schanz, ascribe to them the so-called opthalmia electrica, which resembles snow blindness. Both the crystal lens and the retina of the eye are said to be affected by ultra-violet rays. Dr. Voege, of the physical government laboratory of Hamburg, has recently described experiments which he undertook as a result of the paper before mentioned. His chief announcement is that sunlight is far richer in ultra-violet rays than most of our modern artificial lights, with a few exceptions. In his experiments Dr. Voege makes use of a kind of photometric arrangement. Two dim glass plates are so placed that they appear equally bright to the observer. The one plate is illuminated by the diffused light of the sky, the other by the lamp under test. When the photometric adjustment has been effected, photographs are taken, always under exactly similar conditions, with similarly emulsified plates. As the field consists of two halves, we should get two dark spots of unequal intensity if there is any difference in the proportion of actinic rays. The field is further subdivided by placing a screen of window glass over the upper half, and a screen of quartz glass over the other. Thus four sectors are obtained. Dr. Voege concludes that, provided we arrange our lamps in such a way that we do not directly see the glaring filament and the arc, the eye receives less ultra-violet light from the lamps than it receives with sunlight of equal intensity. The eye, however, does not resemble a sensitized plate, and we have to rely upon our own experience unless we are ready to submit ourselves to dangerous experiments, such as Dr. Burch and others have undertaken for the direct study of fatigue of the eye. Individuality, no doubt, plays an important part. As long as we do not understand the problem general care is most advisable. Too much light may be nearly, if not quite, as bad as too little.—*Abstracted from Engineering (London), August 21.*

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

The "H. & H." Struck-Up Plate.

The Hart & Hegeman Manufacturing Company, Hartford, Ct., has placed on the market a struck-up plate for push switches. An idea of the appearance of this plate can be gained from the accompanying illustration. This device is made in single plates only, and can be used with other makes of push switches



"H. & H." Struck-Up Plate.

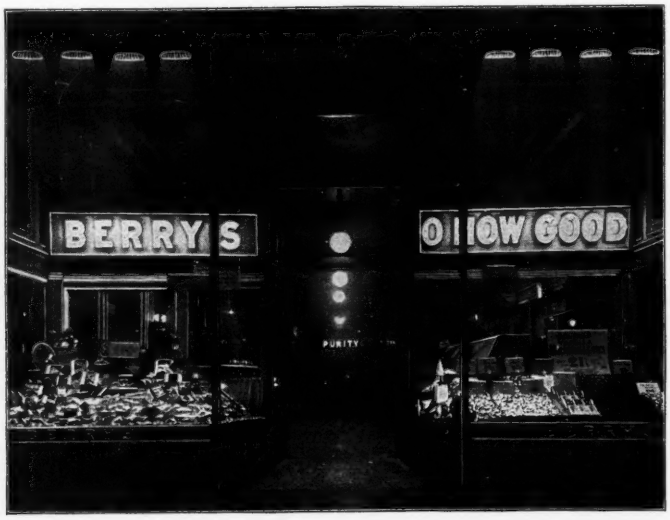
as well as the "H. & H." The plate is made of sheet brass 0.05 inch thick. It can be bought for quite a little less than a solid plate, and, the company states, looks just as well and will answer every purpose. The finishes are nickel, old brass, brush brass and oxidized copper.

Westinghouse Postponement.

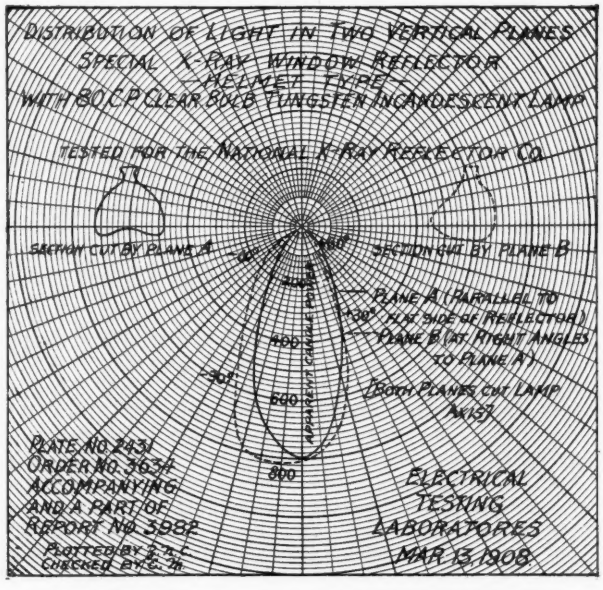
It has been announced that there will be no meeting of the readjustment committee of the Westinghouse Electric and Manufacturing Company to hear the report of the creditors' committee until September 21. September 1 was the last day for the acceptance of the proposed readjustment plan by the creditors and shareholders. The plan provides for the acceptance of new full-paid stock by the mercantile creditors in exchange for their claims; for a pro rata subscription by present shareholders to $6,000,000 new stock for working capital; and for the acceptance by banking creditors of fifty per cent in convertible five per cent bonds and of fifty per cent in fifteen-year five per cent notes.

The New Helmet-Tungsten System of Show-Window Lighting.

The accompanying illustration of Berry's candy-store windows, at 180 State street, Chicago, Ill., affords an interesting demonstration of up-to-date methods in illuminating show windows. The dimensions of the window are eight and one-half feet long, six feet deep and twelve feet high. The former lighting arrangement of the windows consisted of twenty-five feet of continuous trough reflector installed at the top of the window on all four sides, and operated with twenty-five sixteen-candle-power lamps giving approximately 1,250 downward candle-power, consuming 1,400 watts. The new installation consists of four Helmet reflectors, each reflector equipped with a



Show-Window Illumination with Special X-Ray Reflector of the "Helmet" Type.


DISTRIBUTION OF LIGHT IN TWO VERTICAL PLANES
SPECIAL X-RAY WINDOW REFLECTOR
HELMET TYPE
WITH 80 C.P. CLEAR 80 C.B. TUNGSTEN INCANDESCENT LAMP
TESTED FOR THE NATIONAL X-RAY REFLECTOR CO.
SECTION CUT BY PLANE A
SECTION CUT BY PLANE B
PLANE A (PARALLEL TO FLAT SIDE OF REFLECTOR)
PLANE B (AT RIGHT ANGLES TO PLANE A)
(BOTH PLANES CUT LAMP AXIS)
APPARENT CANDLE POWER
400
600
800
PLATE NO. 2431
ORDER NO. 3634
ACCOMPANYING AND A PART OF REPORT NO. 3982
PLOTTED BY E.A.L.
CHECKED BY E.H.
ELECTRICAL TESTING LABORATORIES
MAR 13 1908

Distribution of Light in Two Vertical Planes with Special Window Reflector of the "Helmet" Type, Equipped with Eighty-Candle-Power Clear-Bulb Tungsten Lamp.

100-watt tungsten lamp. This gives an illumination intensity of 3,200 candle-power in each window, with a consumption of 400 watts, effecting an actual saving of 1,000 watts per window, and giving an increased illumination of almost double the candle-power.

The Helmet reflector operates at its best efficiency in windows over ten feet high. This reflector was primarily designed on scientific lines for window lighting in connection with sixty or 100-watt tungsten lamps. The photometric curves shown herewith give an intensity of illumination of 800 downward candle-power.

The company states that with the original installation the total maintenance cost per year was $280, as against a cost for similar maintenance of $88 with the new installation.

The Displaying of Lighting Fixtures.

The proper displaying of lighting fixtures in the showrooms of the various dealers throughout the country has long been an unsolved problem, and until recently few attempts have been made to so arrange and display fixtures that both the artistic and lighting effects of different units could be effectively demonstrated.

In many instances it has seemed that the chief object of a display room has been to collect and assemble in as small a space as possible, a large and varied assortment of metal structures, and place them regardless of style or size. Consequently the prospective buyer is led into a maze of metal and frequently emerges from the display room with rather a hazy idea of just what has been seen or purchased.

Recognizing that this method of displaying fixtures is not conducive to good selection by the customer or satisfactory sales, the Central Electric Company, Chicago, has completely equipped a series of artistic display rooms, one room of which is shown in the accompanying illustration. The other rooms are all conveniently connected and fully equipped with appropriate furnishings.

Each fixture is so located and connected that the lighting effects as compared with another style of fixture, can readily be shown. Crowding of fixtures has been avoided by using large rooms, the furnishings of which are selected with good judgment and taste.

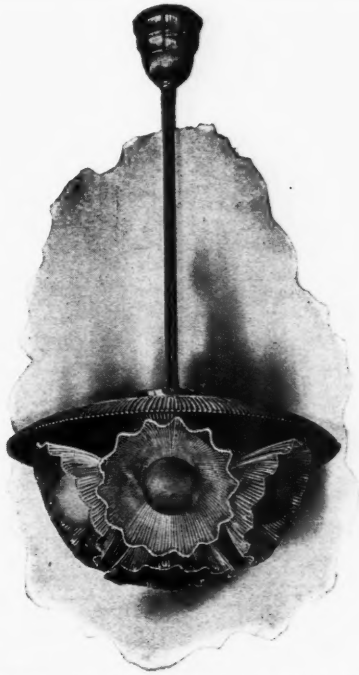
Illuminating and consulting engineers, architects and contractors find the conveniences offered by these new display rooms very useful in bringing clients to a final decision in selecting lighting effects.

FIXTURE-DISPLAY ROOM, CENTRAL ELECTRIC COMPANY, CHICAGO, ILL.

Holophane Arcs with Tungsten Lamps.

Official announcement is made by the engineering department of the National Electric Lamp Association that it is now safe and practicable to burn forty and sixty-watt tungsten lamps at an angle. This means that these lamps may now be used with the popular Holophane arc.

With characteristic conservatism the Holophane company has waited for official sanction from the lamp engineers before recommending this unit with tungsten lamps, although for many months it has been well known that these lamps could be so burned without danger. As long ago as last May an installation of thirteen No. 66 Holophane arcs was made in the "Knox Five and Ten Cent Store," in Bloomington, Ill. Three months later it was reported that not a single lamp had burned out, despite the fact that during one of the three months the lamps were in service two-thirds of the entire day, it being a very dark and rainy month. Similar installations were made by J. S. Maltman, of the Kankakee Electric Light Company, Kankakee, Ill., who states that he has had some twenty Holophane arcs equipped with sixty and 100-watt tungsten lamps in service for over three months. Mr. Maltman says, "We have not as yet found any trouble with the tungsten lamps burning at an angle, and I do not hesitate to recommend to our customers the burning of tungsten lamps in the Holophane arc."



HOLOPHANE ARC NO. 66, WITH BRASS STEM SUPPORT.

With the sanction of the engineering department of the National Electric Lamp Association and the favorable experience of its customers, the Holophane company is now recommending the Holophane arc for all classes of commercial services with tungsten lamps of the forty and sixty-watt sizes.

Daniels Boulevard Lighting System.

The accompanying illustrations show several units of the "Daniels Boulevard Lighting System"; a line of ornamental lighting specialties recently perfected and placed on the market by the Jandus Electric Company, Cleveland, Ohio. Although no attempt has been made to vigorously exploit the system, the interest manifested by electrical engineers, central stations, architects and civic federations has been most gratifying and confirms the manufacturer's belief that the boulevard lighting system has an important function to perform and that its establishment in the lighting field not only insures better illumination but heralds the disappearance of antiquated and barbaric productions in lighting fixtures.

Although arc lamps have been used for general illumination for thirty years, it is only recently that electrical engineers have devoted much time to the subject of art in the design of outdoor lighting fixtures. In their eagerness to produce apparatus having higher efficiency and greater mechanical strength they have overlooked to a marked degree the development of apparatus embodying artistic as well as utilitarian qualities, and have not fully appreciated the inherent possibilities of making outdoor lighting part of a general decorative scheme.

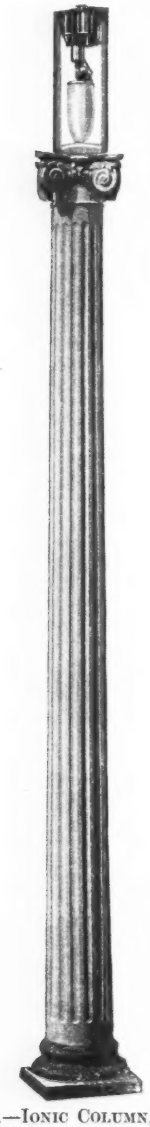


FIG. 1.—IONIC COLUMN, SHOWING METHOD OF ATTACHING LAMP MECHANISM.

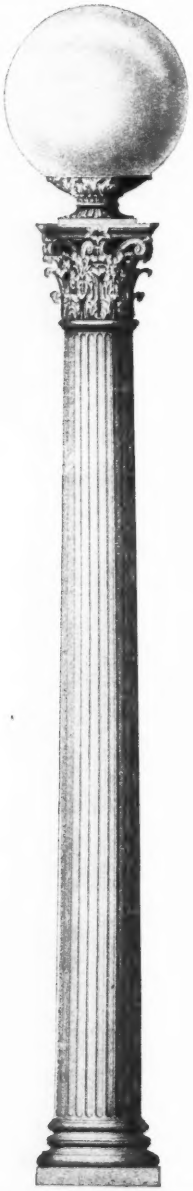


FIG. 2.—COLUMN OF CORINTHIAN DESIGN.

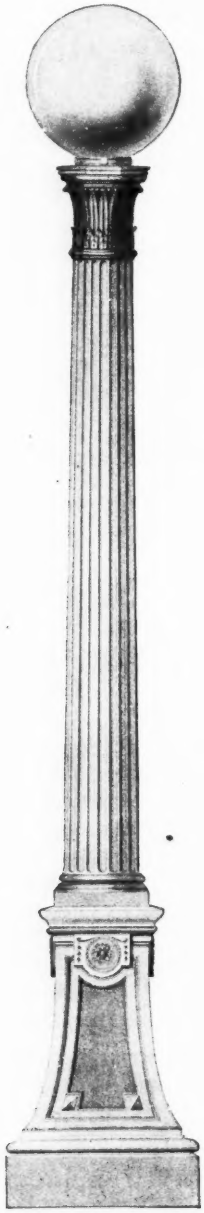


FIG. 3.—THE "BILLINGS POST."

Each unit of the boulevard lighting system consists of a reinforced-concrete post, shaft and capital of classic design, surmounted by a complete arc-lamp mechanism enclosed within a twenty-inch opal glass globe. The post is ordinarily made of reinforced concrete and by proper mixture of ingredients can be made to correspond to sandstone, marble or granite. It is stated that the outfit complete sells for one-half the price of cast-iron; that it is indestructible, requires no painting and is more ornamental than cast-iron jib and goose-neck posts. Cast-iron, pressed-steel,

FIG. 4.—BOULEVARD PRINCIPLE ADAPTED TO WALL BRACKETS.

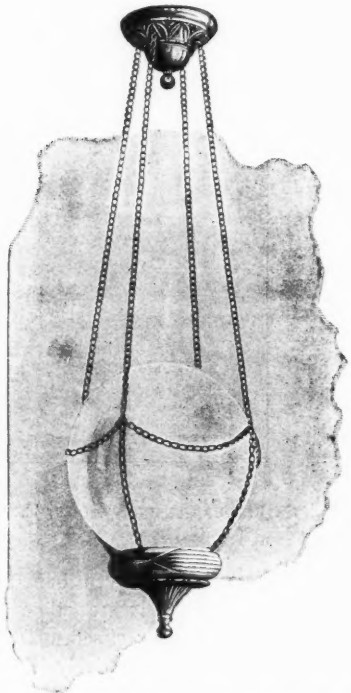


FIG. 5.—JANDUS ORNAMENTAL HANGING LAMP.

copper or bronze posts are furnished when desired.

The lamp mechanism is somewhat shorter than the regular type of arc lamp

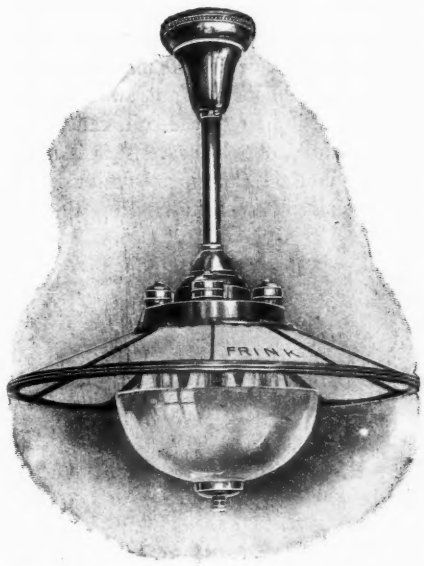


FIG. 1.—TUNGSTEN CLUSTER, WITH SILVER-PLATED, CORRUGATED GLASS REFLECTOR.

but allows the use of nine-inch upper and four-inch lower electrodes, thus insuring a life of 125 hours on multiple direct-current and alternating-current types and 100 hours on series direct-current and series alternating-current types. The use of the large globe insures perfect diffusion, entirely does away with uneven distribution of light due to the travel of the arc and produces a quality of light heretofore unequalled. The system must be seen in operation to be fully appreciated.

Fig. 1 shows the Ionic column and method of attaching the lamp mechanism thereto while Fig. 2 shows the Corinthian design. Fig. 3 shows the "Billings Post," designed by the J. L. Mott Iron Works, New York city, which is particularly attractive. The boulevard principle is applied to wall brackets as indicated by Fig. 4.

A modification of the types above described, the Jandus ornamental hanging lamp, is shown in Fig. 5. This type of arc lamp, designed particularly for store and other indoor lighting is something entirely novel and promises to be a popular specialty.

The lighting of boulevards, parks, public squares, public buildings, capitol grounds, business blocks, private drives, amusement parks and many other applications fall within the sphere of the boulevard lamp.

Frink Reflectors for Tungsten Lamps.

Coincident with the great improvement which has been brought about in the recently developed forms of metallic-filament incandescent lamps, manufacturers of reflecting mediums have shown a great deal of energy and ingenuity in devising auxiliaries which are adapted to utilize with the greatest advantage the increased illumination given by the new light sources. Prominent among the manufacturers of reflectors to create new designs for use with the tungsten lamp is the firm of I. P. Frink, 551 Pearl street, New York city. The accompanying illustrations show some of the most recent designs which this company has placed on the market.

These fixtures have been demonstrated by test to be very efficient for lighting stores, offices, public buildings and show windows generally. The utilization of these forms of reflectors with incandescent light sources is valuable, particularly because they eliminate shadows, there is no flickering, and no glare in the eye of the observer of the illuminated objects.

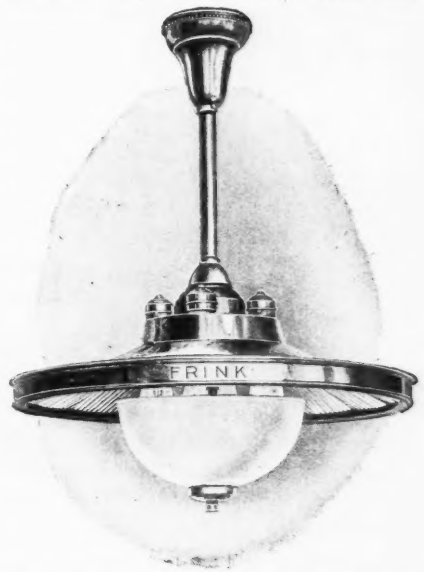
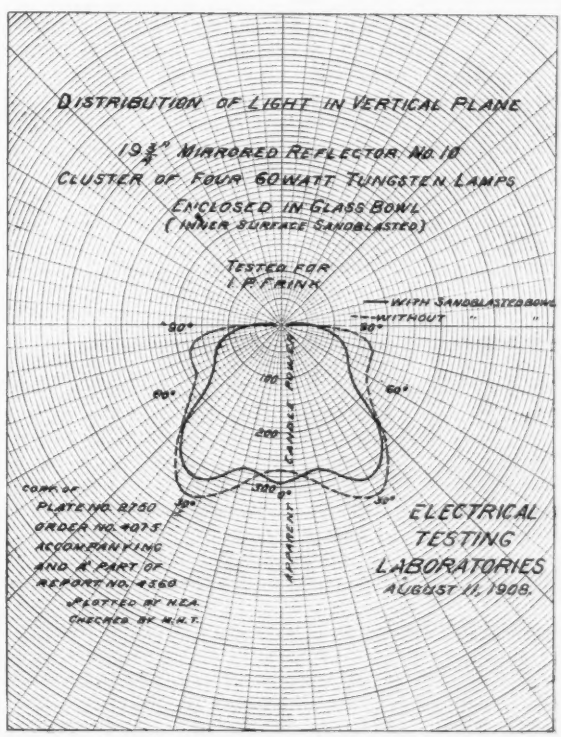


FIG. 2.—TUNGSTEN CLUSTER, WITH SPECIAL IMPORTED OPAL GLASS REFLECTOR.

combinations, for forty, sixty or 100-watt tungsten lamps. The inside of the reflector is lined with the Frink company's special silver-plated corrugated glass, and the lamps are surrounded by a hemispherical opalescent globe. This fixture



CURVES SHOWING DISTRIBUTION OF LIGHT IN VERTICAL PLANE, WITH MIRRORED REFLECTOR, SHOWN IN FIG. 1.

Fig. 1 shows a tungsten cluster, the reflecting medium of which is a mirror reflector with a spread of twenty inches and an over-all length of twenty-four inches. This is made in three, four or five-light is recommended by the company for the solution of problems in illumination where it is desired to give a maximum downward illumination. The accompanying curves, which have been made by the

Electrical Testing Laboratories, New York city, indicate the great increase in candle-power over the prescribed area which is brought about by the use of this reflector.

Fig. 2 is similar in its dimensions and equipment to the fixture shown in Fig. 1 with the exception that the reflecting medium is lined with the company's special imported opal glass. This fixture is recommended particularly where maximum downward illumination is not required, and where the illumination of the higher parts of the room is important.

FIG. 3.—FOR LIGHTING HIGH WINDOWS AND LIGHTING ROOMS FROM ABOVE GLASS CEILINGS.

Fig. 3 shows a special reflector, twelve inches in diameter, which has thirty-two angles of reflection. This reflector, it is stated, will give 350 candle-power with an ordinary thirty-two-candle-power lamp, and is used for lighting high windows and for the illumination of rooms from above glass ceilings. It has proved very satisfactory for installations where a very great increase of candle-power over a prescribed area is desired. The accompanying curve shows the candle-power distribution of this reflector.

Fig. 4 is another special reflector lined with the special silver-plated corrugated glass, and is adaptable for the illumination of show windows. From tests made by the company it has been demonstrated that these reflectors, spaced three feet apart, equipped with sixty-watt tungsten lamps, will give better results than three sixteen-candle-power carbon lamps spaced one foot apart, in ordinary reflectors—that is, there is a consumption of sixty watts, against 168 watts, or a saving of over sixty-five per cent.

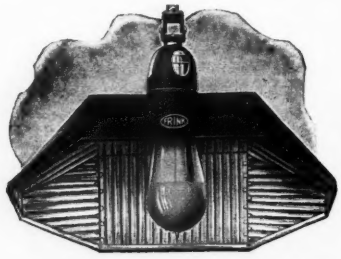
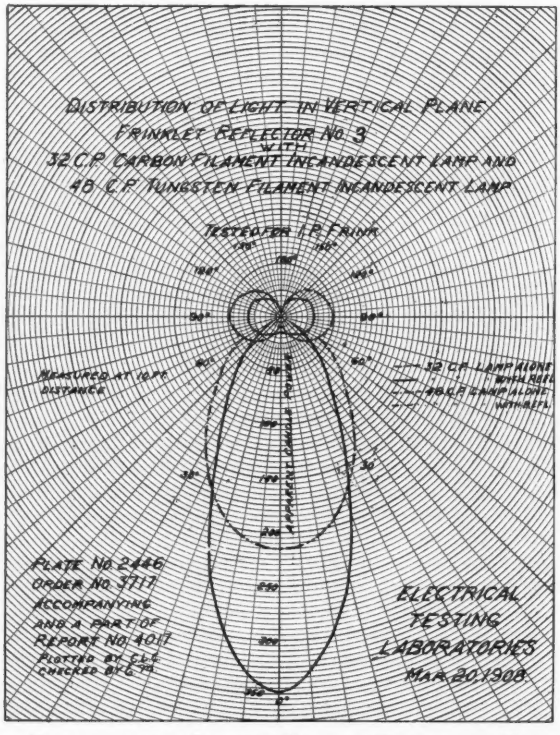


FIG. 4.—SPECIAL WINDOW REFLECTOR.

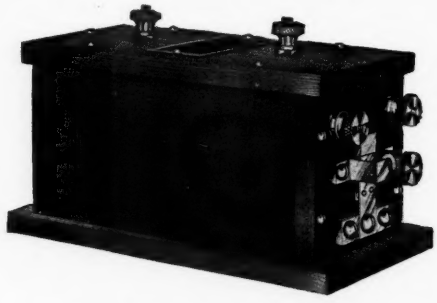

DISTRIBUTION OF LIGHT IN VERTICAL PLANE
FRINKLET REFLECTOR No. 3
WITH
32 C.P. CARBON FILAMENT INCANDESCENT LAMP AND
48 C.P. TUNGSTEN FILAMENT INCANDESCENT LAMP
TESTED FOR I. P. FRINK
MEASURED AT 10 FT. DISTANCE
32 C.P. LAMP ALONE WITH REFL.
48 C.P. LAMP ALONE WITHOUT REFL.
PLATE NO. 2446
ORDER NO. 3717
ACCOMPANYING AND A PART OF REPORT NO. 4017
PLOTTED BY C.L.S. CHECKED BY E.T.
ELECTRICAL TESTING LABORATORIES
MAR. 20 1908

CURVES SHOWING DISTRIBUTION OF LIGHT IN VERTICAL PLANE WITH MIRRORED REFLECTOR SHOWN IN FIG. 3.

Not only are these reflectors made in standard forms, such as are illustrated herewith, but the reflecting medium is of such a nature that special designs can be constructed to meet special requirements, and predetermined results secured with a high degree of accuracy.

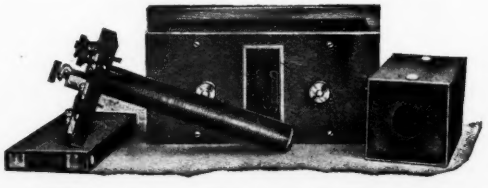
"Cartridge" Jump-Spark Coils.

The "Cartridge" jump-spark coils, manufactured by the Chicago Coil Company, 187 Jackson Boulevard, Chicago, Ill., represent several features of particular merit in spark-coil construction. The "Cartridge" coil derives its name from the fact that the condenser, as well as the secondary winding of the coil, can be replaced readily or reloaded. This is made possible in the "Cartridge" design without requiring the person handling the coil to disconnect any wires. There are no spring nor screw connections interposed in the battery circuit.



CHICAGO CARTRIDGE COIL ASSEMBLED.

The vibrator used on the "Cartridge" coil is so designed as to give the greatest speed possible, and is provided with contacts both on the armature and adjustment screw, made of pure platinum alloyed with twenty-five per cent of iridium.



EXPLODED VIEW OF CHICAGO CARTRIDGE COIL.

One of the important features of the "Cartridge" coil is the construction of its windings, both of which employ black enameled magnet wire. The secondary and primary windings of the coils have a layer of very high insulating paper, especially prepared, between each layer of wire. After the coils are wound and put into the containers, these containers are filled with special insulating compound and placed in a vacuum pan, where all air and moisture are withdrawn.

All spring connections on the secondary cartridge and condenser are made of German silver, and bear heavily against three corresponding contact buttons, so that a continuous circuit is maintained at all times.

The designer and patentee of the "Cartridge" coil is H. D. Stroud, for several years an electrical designer and engineer with the Western Electric Company.

Holophane D'Olier Metal Reflectors.

The Holophane Company, New York city, has acquired, and hereafter will have exclusive control of, the metal reflectors designed by, and manufactured under patents of, Henry D'Olier, Jr. It is the policy of the Holophane Company to maintain leadership in the field of illumination, and this policy has been expressed in the constant improvement of Holophane globes and reflectors.

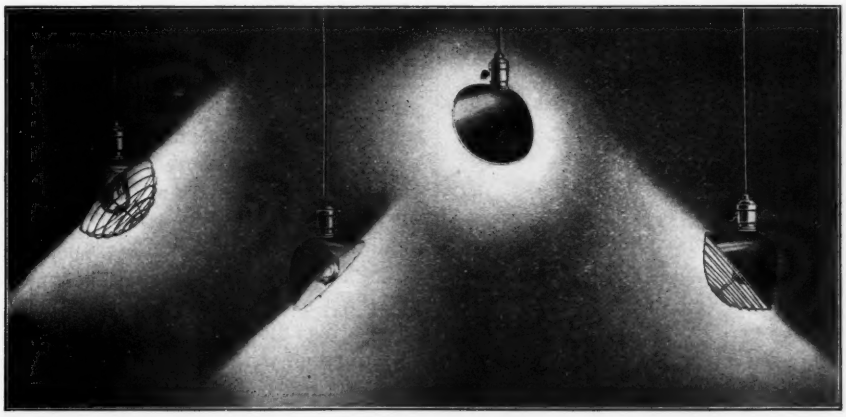
The addition of this line of metal reflectors is a further step in advance. Metal reflectors have a distinct place, and in industrial-plant lighting, in certain classes of display-window illumination, and in many cases where excess of dust and grime or liability to breakage is constant, the use of glassware is almost always inadvisable and frequently absurd.

With the Holophane D'Olier metal reflectors the company is prepared to furnish a line combining scientific design, high efficiency and extreme flexibility.

These metal reflectors are made in twenty-eight sizes and styles, and are furnished in four exterior finishes—brush brass, polished brass, oxidized copper and green enamel. The interior finish in all cases is a "satin aluminum," produced by a secret process, and giving a soft, well-diffused reflection of an almost pure white color.

These reflectors require no shade-holder, as each is provided with an attached clip spring holder reinforced with a heavy steel ring. This can be snapped onto any lamp socket, and while holding the reflector firmly, allows it to be easily rotated about the lamp, thus throwing the light in any desired direction.

These reflectors are wrapped in waxed paper and packed individually in stout cartons. While they are practically indestructible when in service, they are not proof against rough handling and carelessness upon the part of clerks and stock boys. This is but one of the many innovations made by the Holophane Company when assuming control of the D'Olier reflectors.



ANGLE-SET HOLOPHANE D'OLIER METAL REFLECTORS, WITH AND WITHOUT WIRE GUARD.

A Two-Circuit Pendent Switch.

The Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has placed on the market an elaboration of its push-button specialties which were described a few weeks ago. This is a new two-circuit porcelain pendent switch, and contains the same simple three-piece mechanism as the other push-button specialties. The accompanying illustration gives a good idea of the appearance of this device. The body of the switch is of porcelain, the cap of brass provided with a porcelain bushing.

CUTLER-HAMMER TWO-CIRCUIT PORCELAIN PENDENT SWITCH.

This two-circuit pendent switch will fill a long-felt want. A single one of these switches may be used to control two separate light circuits in any of the standard clusters, or to control two separate clusters of lights; or the switch may be so connected that one push-button controls the lights and the other push-button controls some other electrical device, such, for instance, as a fan. Many other applications of this two-circuit switch will readily occur to those familiar with electrical installations.

The Greenwood Adjustable Street-Lamp Guard.

The accompanying illustrations show the Greenwood adjustable street-lamp guard, made by the Greenwood Manufacturing and Supply Company, 141 Milk street, Boston, Mass. This lamp guard is composed of a flat metal band surrounding the hood, made in two distinct parts, with thumbscrews that allow the fastener to be adjusted from twelve to fifteen inches. The guard is hinged to the flat metal band on one side, and provided with a clasp fastener on the other, thus allowing it to swing when it is necessary to renew the lamp. The wires in the guard are of hard-drawn steel, and are laced with fine wires where they meet. The whole guard is galvanized and warranted not to rust.

GREENWOOD ADJUSTABLE STREET-LAMP GUARD.

GREENWOOD ADJUSTABLE STREET-LAMP GUARD, WITH GUARD DOWN, FOR LAMP TRIMMING.

With the introduction of the high-priced, high-efficiency lamps, the electric lighting companies that are using this guard claim a great reduction in breakage. This guard fills a distinct place now that the companies are exercising the greatest possible care to insure long life to the newer types of incandescent lamps.

Air-Blast Transformers for the Calumet and Hecla Transmission System.

The accompanying illustration, Fig. 1, shows an installation of six 500-kilowatt Wagner air-blast transformers at one of the substations of the Calumet & Hecla Mining Company, Calumet, Mich., comprising part of an installation of 500-kilowatt, 2,300-13,200-volt, twenty-five-cycle and 370-kilowatt, 13,200-480-volt, twenty-five-cycle Wagner air-blast transformers, aggregating 10,830 kilowatts, that has been put into operation during the last few years.

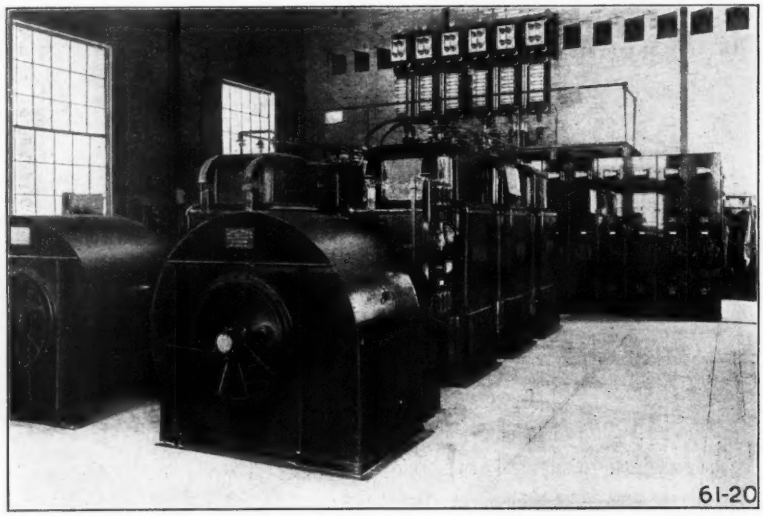


FIG. 1.—VIEW IN CALUMET SUBSTATION, SHOWING SIX OF THE PRESENT INSTALLATION OF NINE 500-KILOWATT WAGNER AIR-BLAST TRANSFORMERS.

The original installation of Wagner transformers consisted of the six transformers shown in Fig. 1 and of three 370-kilowatt, 13,200-480-volt, twenty-five-cycle transformers. In this transmission scheme, power is generated at 13,200 volts, three-phase, and transmitted to various parts of the property controlled by the Calumet & Hecla company. A large portion of the power is transmitted to the substation at Calumet, and is there transformed, by the first-mentioned installation of transformers, at a transmission potentiol of 2,300 volts for various uses about the mines, such as the operation of pumps, machine tool and crushers. Another large part of the power, involving the employment of both 370-kilowatt and 500-kilowatt transformers, is used in the vicinity of the generating station, for operating motors in the stamp-mills and smelters, and other above-ground apparatus; including about 1,500 kilowatts in a new mill that has recently been built about two thousand feet from the generating station.

The generating station is situated at Lake Linden, about seven miles from Calumet, on the property of the Calumet & Hecla Company adjacent to its stamp-mills and smelters.

The original installation proved so satisfactory that a duplicate order, plus an additional unit of 500 kilowatts, was given to the Wagner Electric and Manufacturing Company. Up to the present time the entire installation has worked very satisfactorily under difficult load conditions. Thus, one unusually severe condition has been in the frequent starting of the large motors that are employed on the circuits, which results in occasional extremely heavy overloads. Another feature that had to be guarded against in this installation was the frequent occurrence of severe electrical storms. The storm period in this region lasts throughout the summer months. The transformers were subjected to frequent lightning discharges, but have up to the present time successfully withstood these extraordinary conditions. In one instance the lightning succeeded in getting past the protective devices and into one of the trasformers, but fortunately did no damage beyond burning off a lead, owing to the excellence of the insulation. The transformer was repaired immediately and was put back into service within a few minutes after the occurrence of the discharge.

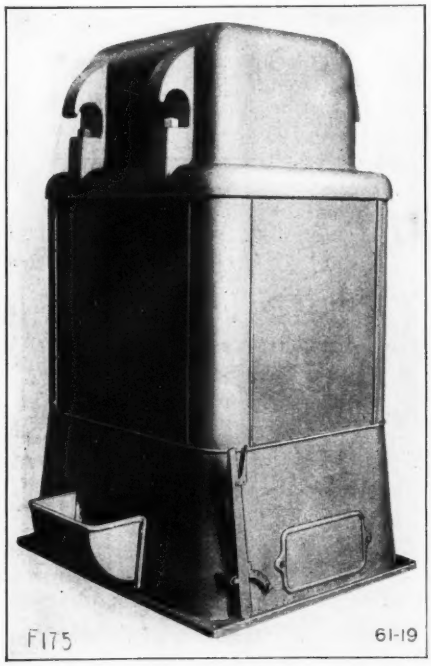


FIG. 2.—WAGNER 13,200-2,300-VOLT AIR-BLAST TRANSFORMER.

Fig. 1 shows six of the present installation of nine 500-kilowatt transformers in the Calumet substation. The two blowers, each of which is driven by a Wagner 440-volt, twenty-five-cycle, seven-and-one-half-horse-power induction motor, have an aggregate capacity adapted to take care of all of the transformers in the substation. The view also shows the low-tension distributing circuits, the portion of the switchboard comprising the 2,200-volt feeder-circuit equipment, the lightning arresters and the apertures in the wall for the admission of the conductors of the three-phase transmission line from the power station seven miles distant.

The construction of the Wagner air-blast transformer presents several interesting features. As shown in Fig. 2, which is a view of one of the 13,200-2,300-volt transformers above referred to, the air passages are so arranged that the air is taken in at the bottom of the coils, and after passing upward through the coils is forced by deflecting screens to pass downward around the iron circuit, and is then discharged by a separate passage through the base of the transformer.

The shutter in the base of the transformer may be so arranged that in the summer time the warm air may be discharged into an underground duct and during the winter out into the air of the substation for heating purposes.

The transformers are of the shell type, with pancake-coil windings giving maximum cooling surface, and at the same time the most favorable disposition of insulation between primary and secondary, and between coils and iron.

Current Electrical News

DOMESTIC AND EXPORT.

PROPOSED WESTERN POWER PLANT—A large electric light and power plant, costing $6,000,000, is soon to be erected near Marblemount, on the banks of the Skagit River, Wash. It is being financed by a syndicate of Denver (Col.) capitalists. The constructing engineer, with a corps of ten assistants, is on the ground. A track is to be built from Rockport to enable the builders to secure machinery and supplies.

TELEPHONE MERGER EFFECTED—It is announced that a company will be incorporated to lease the properties of the United States Telephone Company, the Cuyahoga Telephone Company, of Cleveland, Ohio, and the Citizens' Telephone Company, of Columbus, Ohio. Options have been taken on these properties by the new company. The United States Telephone Company, operating long-distance wires, is capitalized at about $4,000,000. It operates over 12,000 miles of long-distance wires, connecting 300,000 independent telephones, and controls nine local companies. The Cuyahoga company is capitalized at $3,000,000 and the Citizens', of Columbus, at $700,000.

INTERURBAN RAILROAD ORGANIZED—The Iowa Interstate Railway Company has been organized in Des Moines, Iowa, and officials, all well-known Des Moines men, elected. Articles of incorporation will be filed shortly. The proposed road is to be built from Council Bluffs to Muscatine by way of Des Moines. The promoters of the project state that the final arrangements for a working capital of $10,000,000 have been made. The portion between Des Moines and Council Bluffs will be built first. It will not run directly through Des Moines, but will run into the city from Springhill, by way of the army post. From Springhill the line will run west through Winterset, Greenfield, Fontanelle, Cumberland, Lewis and Oakland, and thence direct to Council Bluffs. The eastern section of the line, to be built later, will run almost due east from Springhill to Muscatine, *via* Indianola, Knoxville, Oskaloosa, Sigourney and Washington. It is stated by the promoters that work will be commenced at once and pushed to completion at the earliest date possible.

ELECTRIC LIGHTING.

REEDSVILLE, WIS.—The municipal light plant has been closed indefinitely. The plant cost about $15,000.

PIQUA, OHIO—L. A. Pearson, of West Milton, has been granted a twenty-year franchise and contract for furnishing the town with electric lights at his bid of $85 per arc lamp per year.

LITTLE ROCK, ARK.—Robert Crowe, of Arkadelphia, is in Nashville figuring on a proposition to establish an electric light plant at that place. The city council, it is said, is disposed to grant the franchise asked for by Mr. Crowe.

WILKES-BARRE, PA.—It is stated that the building of a large new electric power station in Lapland is shortly to be taken in hand. Either the Norr or Soderland Falls will be used. The power available is estimated at 88,000 horse-power.

BUTTE, MONT.—John D. Ryan and other new owners of the Great Falls Water and Power Company, supposed to represent Amalgamated interests, announce their intention to build a new dam on the river at Great Falls and develop 23,000 horse-power.

ANDOVER, N. B.—At a meeting of the members of the electric light district of Andover and Perth it was decided to install an electric light plant in this district at once and to enter into a contract with the New Brunswick & Maine Power Company to supply the power.

ISHPEMING, MICH.—A material enlargement of its water-power plant at Quinnesee Falls, on the Menominee River, is planned by the United States Steel Corporation. It is proposed to use the power for the operation of the machinery at the Aragon property at Norway also.

KIRKLAND, WASH.—A franchise has been granted by the council authorizing the Kirkland Light and Power Company to furnish electric light to this town and the adjoining neighborhood. James Bell and T. L. Kiler are behind the project. The company plans to begin work at once.

TOPPENISH, WASH.—Material is arriving for the electric light and power plant of the Reservation Electric Light Company. The managers are A. H. Campbell and M. Kramer, recently of Seattle. They expect to give a twenty-four-hour service and to have the plant in operation by November 1.

PLATTEVILLE, WIS.—It is said that the Fox interests, which recently purchased Galena's municipal plant, expect to be ready to furnish power and commercial lighting within three months. Eventually they will build a power plant capable of furnishing electrical power for all the mines in the district.

LINDEN, ALA.—A move is now on foot to supply Linden with electric lights. Plans are being perfected whereby J. A. Johnson and his brother, O. A. Johnson, will be granted permission by the city council of Linden to erect, equip and maintain an electric light plant sufficient to furnish at least 800 electric lights.

CHARLOTTE, N. C.—The Southern Power Company has placed an order with Milliken Brothers, of New York, for 2,000 steel towers, at a cost of $250,000. These towers will carry 100,000-volt lines. The company will let another contract representing an expenditure of about $60,000 for the Loray Cotton Mill at Gastonia, N. C.

MACUNGIE, PA.—Macungie will have an electric light and power company. An organization is now being formed, and, it is stated, will start operations as soon as a charter is granted. It is also stated that Slatedale, in Washington Township, will have an electric light and power company. The town has a population of 1,200.

BALLINGER, TEX.—Representatives of an eastern company have made application for a franchise to establish and maintain in Ballinger an electric light and power plant. Ballinger already has a light plant. The new company proposes to furnish the city free of cost ten arc lights and to give service at a rate ten per cent below the present rate.

AUSTIN, TEX.—The Water, Light and Power Commissioners will receive bids until September 19 for constructing a reinforced concrete addition to the municipal pumping station, approximately eighty-nine by sixty-four by thirty-five feet. For specifications, blank forms and other information address Walter G. Kirkpatrick, engineer, Jackson, Miss., or the Water, Light and Power Commissioners, Austin, Tex.

BOONTON, N. J.—Papers of incorporation of the Boonton Electric Company have been filed in the Morris County clerk's office. It is understood that the new company has or shortly will take over the Public Service plant in Boonton on a lease. The authorized capital stock is $100,000, of which $1,000 is paid in. Senator Thomas J. Hillery has eight shares and is the agent in charge. Other incorporators are John J. Hillery and Anna Hillery.

PRESCOTT, ARIZ.—Similar to the work now being done by the Arizona Power Company at Fossil Creek are the plans of the Verde River Power Company, which, at a point four miles below the mouth of Fossil Creek, is preparing to develop 2,500 horse-power by damming the Verde at a point where a considerable fall can be secured. The dam will be in the vicinity of Bloody Basin, in one

of the roughest parts of Arizona. The estimated cost of the plant and transmission lines is $400,000.

ALBANY, N. Y.—The Public Service Commission, Second District, has denied the application of the Hudson River Water Power Company for authority to issue $62,000 first mortgage bonds; also the application of the Hudson River Electric Company for consent to transfer to the Hudson River Water Power Company the electric power transmission line running from Ballston Spa to Alplaus, and for authority to acquire $51,000 bonds of the Hudson River Water Power Company in payment therefor.

AUBURN, N. Y.—With an expenditure of approximately $30,000, the Auburn Light, Heat and Power Company contemplates duplicating its present equipment at the North street power-house. Plans for the new work are now ready and the individual contracts will soon be let. The company intends to increase its lighting facilities to correspond with the increased demand for power. Superintendent M. Curry Turpin stated that work on the alterations of the plant will commence soon. It is expected that about four months will be required to make the changes.

EL PASO, TEX.—E. Krause and W. E. Fletcher, of this city, have bought up the water rights along the Penasco River, in the Sacramento Mountains north of El Paso, and will divert the waters of the river into a canal, then into Cox Cañon, near Mayhill, N. M., and from the power thus generated distribute electric current throughout this section of the country. They claim that they will distribute current in El Paso at one and one-half cents per horsepower-hour, and that there will be sufficient to supply Alamogordo, Cloudcroft, Orogrande and other New Mexico towns, in addition to this city. It will take $500,000 to finance the deal, and it is stated that actual construction work will be under way in eight months.

JESSUP, PA.—Jessup has formed a stock company which will construct a modern electric light plant to supply current for street and commercial purposes. The company is capitalized at $25,000, and a ten-year contract has been made with the borough council for fifty street arc lights. The stock has been nearly all subscribed for by local people. The officers are: President, J. J. Sweeney; secretary, B. J. McGurl; treasurer, W. G. Robertson. The contract for the construction of the plant has been awarded to the Scranton Electrical Construction Company, of Scranton. The building will be of brick. The board of directors comprise: Rev. J. M. Smauler, W. G. Robertson, J. H. Hemelright, C. P. Ford, J. J. Sweeney, B. J. Cummings, A. J. Smalco, John Forini, John Slwka, H. V. Lawler and B. J. McGurl.

ALBANY, N. Y.—The Public Service Commission, Second District, has granted the application of the Madison County Gas and Electric Company for consent to issue $45,000 in gold bonds under a first consolidated mortgage. The order is made conditional that the bonds be sold at not less than eighty, and that the capital secured from the sale of the bonds be devoted to and used for the construction of a 60,000-volt transmission line from the steam plant of the Madison County Gas and Electric Company in Oneida to Oneida Castle and for the purchase of the necessary right of way therefor and installation in Oneida of a proper generator and the necessary instruments and appliances, for putting in proper repair an overhead system of the Madison County Gas and Electric Company in Oneida, and changing a part of the system from sixty to forty cycles.

ALBANY, N. Y.—The Public Service Commission, Second District, recently gave a hearing upon the application of the Newburgh Light, Heat and Power Company for permission to issue convertible debenture bonds in the aggregate sum of $350,000. The commission on April 29 issued its order authorizing the issue of eight per cent debenture bonds of the aggregate par value of $330,000. Since the granting of the order the company has taken up a new proposition whereby it is to take over the properties of the Hudson Counties Gas and Electric Company for the supply of electric current generated at Honk Falls on condition that the transmission line be constructed from the generating station in the city of Newburgh through the towns of Newburgh, Marlborough, Lloyd and New Paltz and the station of the Honk Falls Power Company at High Falls on Rondout Creek, and for that reason it has abandoned its proposition to erect a new steam power electric generating station in Newburgh.

ELECTRIC RAILWAYS.

TOLEDO, OHIO—The Toledo, Ann Arbor & Detroit electric line is to be offered for sale by order of the special master in chancery under mortgage foreclosure decree on October 12, at Monroe, Mich.

PHILADELPHIA, PA.—The J. G. Brill Company has received an order for seventy-five pay-as-you-enter cars from the New York City Railway Company. The cars are to be delivered as soon as possible.

CHICAGO, ILL.—The Aurora & Rockford Electric Company is being reorganized. The American Trust and Savings Bank has filed a petition to foreclose the $750,000 mortgage. Two receivers have been appointed.

FREDERICKSBURG, VA.—The preliminary survey for the West Point-Urbanna electric line has been completed. The route surveyed is from Chain Ferry to Saluda, thence across to Urbanna, near Oakes Landing. It is eighteen miles long.

MILWAUKEE, WIS.—Cars are now running from Milwaukee to Cedar Grove over the Milwaukee-Northern road. Cedar Grove is fifteen miles from Port Washington, the present terminus. The extension is being pushed rapidly from Port Washington to Sheboygan.

EASTON, PA.—The promoters of the proposed trolley line to connect the Easton & Washington traction line with Hackettstown and also construct another branch by way of Netcong to Newton say the necessary capital has been subscribed and that the lines will cost $1,000,000.

LANSING, MICH.—Articles of incorporation of the Saginaw & Flint Railway, capital $100,000, have been filed with the secretary of state. The company proposes to connect the two cities with an electric line and also run a branch to Vassar. Alexander Groesbeck, Nelson A. Taber and Mark Mitshkun are the incorporators.

LAPORTE, IND.—The Chicago, South Bend & Northern Indiana Railway has finished the construction of the Laporte extension of the line running west from South Bend. The opening of the road gives South Bend another outlet to the lake, and will connect Laporte and Michigan City with Elkhart, Goshen and Warsaw.

TACOMA, WASH.—Announcement is made by Manager E. J. Felt that the Pacific Traction Company expects to be in a position soon to complete the construction of the extensive street-car system in Tacoma it had heretofore planned. In addition to the line it now has in operation to American Lake the company has franchises for routes covering almost the entire city.

MILWAUKEE, WIS.—The petition of the Milwaukee Light, Heat and Traction Company for a certificate of convenience and necessity for an electric railway line to Hartford, in Washington County, will be heard by the Railroad Rate Commission in Madison, September 17. The proposed line is to run on Fond du Lac road through the towns of Granville, Menominee, Richfield and Polk.

STREATOR, ILL.—Actual construction work on the Chicago, Ottawa & Peoria interurban line between Grand Ridge and this city will be started shortly. D. McAfee, the company's representative, is engaged in arranging the final details for the starting of the work. It is now the intention to start building in this city and push the work as rapidly as possible until it has been completed to Grand Ridge.

FINDLAY, OHIO—Citizens of this place met with the projectors of the Findlay & Marion electric line and agreed to undertake the work of raising $125,000 necessary for the road's financiering. A like amount will be raised by Marion citizens. Already $800,000 worth of bonds has been sold to eastern parties. It is thought that work on the construction of the road will begin at once. It will be forty-eight miles long.

NEW YORK, N. Y.—Operations are to be begun at once on the construction of a double-track trolley line from Flushing to Bayside and Whitestone. The road will be five miles long, and will open for development much new territory along the north shore of Long Island. The franchise under which these improvements will be made was granted to the New York & Queens County Railway Company recently.

PERSONAL MENTION.

MR. FRANK B. KNIGHT, of Dallas, Tex., one of the pioneer telephone men of the United States, is renewing old-time friendships in New York city this week.

MR. VINCENT GRAY, formerly with the Columbia Incandescent Lamp Company, in charge of the Illinois district, has accepted a connection with the Westinghouse Electric and Manufacturing Company, and will have charge of the lamps, detail and supply business of the Milwaukee sub-district office.

MR. WILLIAM H. McKINLOCK, president of the Metropolitan Electrical Supply Company, Chicago, has been spending some days in New York city among old electrical friends and also visiting C. Edward Murray, of the Crescent Insulated Wire and Cable Company at his summer home at Sea Girt, N. J.

MR. EARLE T. HOBART, of Brookline, Mass., has started for San Francisco, whence he will sail for China the latter part of September under a three years' engagement with the College of Science at Pekin, China. He will establish and equip a department of electricity in connection with this institution, and the department will be the first of its kind in China. Mr. Hobart was graduated from the Brookline High School in 1904, at the age of eighteen, and from the department of mechanical and electrical engineering of Cornell University last June. In July he entered the employ of the General Electric Company at Lynn, Mass., and two weeks later received the appointment to China.

MR. R. F. MORRIS, who for a number of years has been manager of the Richmond (Va.) exchange of the Southern Bell Telephone and Telegraph Company of Virginia, resigned on September 1. Albert S. Tanner, long connected with the company at Richmond and other points, will succeed Mr. Morris as manager of the Richmond exchange. Mr. C. W. Connors, manager of the Opelika (Ala.) office of the Southern Bell Telephone and Telegraph Company, has been transferred to the commercial department of the company at Montgomery, Ala. He is succeeded by W. E. Bare, who has been manager at Alexander City. Mr. Robert M. McCandlish has been placed in charge of the Hampton and Newport News (Va.) exchanges. Spencer Henley, who has been in charge of the Newport News office, has been transferred to Lynchburg, Va.

MR. P. S. MUELLER has opened an office in the Electric Building, Cleveland, Ohio, as a general selling agent, where he will keep open house and be pleased to meet his old friends and patrons in the electrical field. Mr. Mueller was graduated from the electrical course of the University of Nebraska in 1898, and shortly afterward entered the telephone switchboard shops of the Western Electric Company, Chicago. He spent two years in the shops and in telephone installation work and on the road. The two years following he was connected with the Chicago office of the Westinghouse Electric and Manufacturing Company, but decided to go back into the telephone business, and in the fall of 1902 entered the employ of the Kellogg Switchboard and Supply Company. He was in the publicity department of this company, and for a short time had charge of the Philadelphia and Cleveland offices. Mr. Mueller will represent in Ohio and West Virginia the following firms: Alfred F. Moore, Philadelphia, manufacturer of insulated wires and cables and all sorts of telephone cordage; the Stackpole Battery Company, St. Marys, Pa., manufacturers of dry cells and carbon products; the Warner-Newton Lumber Company, Grand Rapids, Mich., producers of cedar poles and posts; the Yesbera Manufacturing Company, Toledo, Ohio, builders of telephone booths; the General Insulate and Machine Company, Brooklyn, N. Y., manufacturers of receiver shells and other hard-rubber substitutes.

OBITUARY NOTE.

MR. B. F. ELLISON, for eight years general manager of the Superior Water, Light and Power Company, Superior, Wis., died on September 1 at the home of his brother-in-law at St. Paul, Minn., from a complication of diseases. Mr. Ellison had been ill for some time, and his death was not unexpected. He was born at Utica, N. Y., fifty-five years ago, and previous to his connection with the Superior Water, Light and Power Company was associated with the St. Paul (Minn.) Gas Light Company. He is survived by a widow and four children.

ELECTRICAL SECURITIES.

During the short week the stock market witnessed a somewhat irregular decline, with trading moderately active, and largely professional. Professional sentiment appears to be decidedly bearish, and there was little brought out in the way of news or events to stimulate bull activity. The outcome of the Vermont election, which is generally considered to predict a Republican victory in November, had a hopeful influence on the stock market, while the report of the American Smelting interests had a most depressing tendency. It appears that these stocks, instead of being held by a few strong interests, are widely scattered, with little or no coherence in any endeavor to maintain prices at what appears to be their intrinsic position. There is beginning to be some apprehension concerning the outcome of the crops which are about to be harvested. Disappointing reports have come to hand, and while the yield will be as large as even in record years, it is not apparent that there will be any very great surplus to dispose of abroad. This condition, however, may be greatly changed in favor of the agriculturists before the next report is due.

Dividends have been declared upon the following electrical securities: Chicago City Railway Company; regular quarterly dividend of 1½ per cent, payable September 30 to stock of record September 14. Philadelphia Traction Company; regular semiannual dividend of $2 per share, payable October 1 to stock of record September 5. Interborough Rapid Transit Company; regular quarterly dividend of 2¼ per cent, payable October 1 to holders of stock and voting trust certificates of record September 14. Canadian General Electric Company, Limited; quarterly dividend of 1¾ per cent on the common stock for the three months ended September 30, and a semiannual dividend of 3½ per cent on the preferred stock for the six months ended September 30, both dividends payable October 1.

ELECTRICAL SECURITIES FOR THE WEEK ENDED SEPTEMBER 5.

New York:	*Closing.*
Allis-Chalmers common	11⅛
Allis-Chalmers preferred	35
Brooklyn Rapid Transit	54⅜
Consolidated Gas	148⅞
General Electric	146¼
Interborough-Metropolitan common	11¾
Interborough-Metropolitan preferred	33½
Kings County Electric	122
Mackay Companies (Postal Telegraph and Cables) common	68¾
Mackay Companies (Postal Telegraph and Cables) preferred	68
Manhattan Elevated	137
Metropolitan Street Railway	30
New York & New Jersey Telephone	110
Western Union	57
Westinghouse Manufacturing Company	75½

Boston:	*Closing.*
American Telephone and Telegraph	130½
Edison Electric Illuminating	235
Massachusetts Electric	46
New England Telephone	119½
Western Telephone and Telegraph preferred	75

Philadelphia:	*Closing.*
Electric Company of America	9⅞
Electric Storage Battery common	38
Electric Storage Battery preferred	38
Philadelphia Electric	9⅞
Philadelphia Rapid Transit	13⅞
United Gas Improvement	87⅞

Chicago:	*Closing.*
Chicago Telephone	148
Commonwealth Edison	107
Metropolitan Elevated preferred	44
National Carbon common	70
National Carbon preferred	109

NEW INCORPORATIONS.

BURLINGTON, VT.—Cory-Deavitt-Frost Electrical Company. $150,000. Incorporators: F. M. Corry, E. H. Deavitt, I. M. Frost, L. D. Taft and W. T. Dewey.

GALION, OHIO—Marion & Galion Electric Railway Company. $10,000. To build an electric road between Marion and Galion. Incorporators: F. H. Murphy, of Cleveland, Ohio, and others.

COLUMBUS, OHIO—Springfield Light, Power and Heat Company, Springfield. $1,000,000. Incorporators: Joshua D. Price, W. W. Keifer, W. H. Sharp, C. S. Kay, L. M. Ferguson, F. M. Hagan.

TELEPHONE AND TELEGRAPH.

BURLINGTON, VT.—The directors of the Orange County Telephone Company have decided to build a trunk line from East Montpelier to Plainfield.

MUNCIE, IND.—The Home Telephone Company, of Gaston, has completed and placed in operation its system. The company is composed of residents of Gaston.

MAYSVILLE, KY.—J. D. Powers has been appointed receiver for the Central Home Telephone Company, of Louisville, by Judge Cochran, of the United States District Court. The company owns many long-distance lines.

TUCSON, ARIZ.—The Arizona Overland Telephone Company now has its line in operation from Roosevelt to Fossil Creek, where it will be connected with the line from Flagstaff. It is the intention to incorporate the Fossil-Flagstaff line into the Overland, thus bringing it under one management. That accomplished, the new company contemplates getting control of the line between Globe and Mesa.

SALT LAKE CITY, UTAH—Connection by the Utah-Nevada & Idaho Telephone Company with Nevada-Salt Lake points has been completed. This is the first link in the system which will ultimately connect Salt Lake with San Francisco and Los Angeles. The crews have been laid off with the completion of this 211-mile line, and work will be resumed at Shafter in September for the completion of the line to Ely. The opening of the line to Wells gives telephone connection with all of Elko County, furnishing direct conection with Elko, Deeth, Tuscarora, and as far north as the Duck Valley Indian reservation, leaving a gap of less than thirty miles to be constructed in order to secure communication with Gold Circle, Golconda and Winnemucca, at which points the company is already operating telephone plants. Arrangements are being made for taking over the system at Pioche, with the radiating toll lines. It is the company's intention to build as quickly as possible between Ely and Pioche, which will bring this southern system of telephones in direct communication with Salt Lake City.

INDUSTRIAL ITEMS.

THE NOVELTY INCANDESCENT LAMP COMPANY, Emporium, Pa., is issuing a pretty calendar card for September.

HARVEY HUBBELL, Bridgeport, Ct., has ready for distribution some attractive literature devoted to the Hubbell pull socket and Hubbell attachment plugs for electric fans and fixtures.

THE DALE COMPANY, Ninth avenue and Hudson street, New York city, has published a neat booklet devoted to the Dale designs for tungsten lamps. Copies of this booklet will be furnished upon request.

THE ECONOMY ELECTRIC COMPANY, Warren, Ohio, is making some very attractive announcements concerning its large supply of renewed lamps. The company offers a 3.1-watt lamp at an extremely low figure.

THE M. W. DUNTON COMPANY, 65 Atlantic avenue, Providence, R. I., announces a new line of special friction tape which will be known as the "Black Diamond." A free sample of this tape will be sent upon application.

THE BRUNSWICK REFRIGERATING COMPANY, New Brunswick, N. J., will be pleased to send to those interested upon request some new literature devoted to refrigeration in model homes, and general data concerning refrigerating apparatus.

D. C. & WILLIAM B. JACKSON announce that they have moved their western office from Madison, Wis., to the Commercial National Bank Building, Chicago, Ill., and that Mr. William J. Crumpton will be in immediate charge of the Chicago office.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., has opened a new office in the Gumbel Building, Kansas City, Mo., for the sale of Crocker-Wheeler motors, dynamos, transformers, switchboards, etc. The office is in charge of A. W. Paine.

THE WHEELER CONDENSER AND ENGINEERING COMPANY, West Street Building, New York city, has ready for distribution bulletins describing the Edwards patent air-pumps and the company's products and facilities. Copies of these bulletins will be furnished to those interested upon request.

THE NERNST LAMP COMPANY, Pittsburg, Pa., has published a handsome catalogue describing and illustrating the Westinghouse Nernst lamp. This catalogue is of particular interest at this time, as an entirely new unit, and one which will prove a decided factor in lighting conditions, is described. A comparative table of Westinghouse Nernst and other electric lamps introduces some very interesting figures.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., is distributing bulletin No. 3,135, devoted to single-phase induction motors, frame 32DD, one-tenth, one-eighth and one-sixth horse-power, light-load start, for intermittent service; bulletin No. 3,706, devoted to electric buffing lathes for alternating and direct current; bulletin No. 3,958, devoted to motors for family washing machines.

THE AMERICAN CIRCULAR LOOM COMPANY, Boston, Mass., announces that its new factory at North Cambridge, Mass., is now in full operation, and that all orders for "Circular Loom" will be filled promptly. The factory is equipped with the most modern and improved machinery, and the company states that the high standard hitherto set in the manufacture of its product will not only be maintained, but will be heightened by new methods.

THE METROPOLITAN ENGINEERING COMPANY, New York city, on the occasion of the Sherman notification celebration at Utica, N. Y., recently, lent to the Utica Gas and Electric Company a sign constructed of eighteen-inch "Attraction" letters containing 400 sixteen-candle-power lamps. The sign produced the illuminated word "Welcome" on both sides. This is a feature of the Metropolitan company's business that is frequently called for by central stations in every part of the country.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., reports that its incandescent lamp sales for the first half of the present year are more than double its sales for the corresponding period of 1907. This condition of affairs is attributed partly to the fact that the company carries in Chicago, for immediate shipment, a large stock, in all standard voltages and candle-powers, of high-efficiency units, such as Columbia tungsten and tantalum lamps, as well as Columbia carbon-filament lamps, and due also to the excellent quality of the Columbia products.

THE WESTON ELECTRICAL INSTRUMENT COMPANY, Waverly Park, Newark, N. J., has issued circular No. 7, descriptive of new Weston instruments for both alternating and direct currents. This is divided into three parts. Part 1 describes and illustrates switchboard and alternating-current ammeters and voltmeters in two sizes, models 151 and 156; part 2, portable alternating-current ammeters, milli-ammeters and voltmeters, model 155, and part 3, "Eclipse" direct-current switchboard instruments of the electromagnetic type, models 159 and 160. The company will be pleased to send this circular upon request to any one interested.

THE EDISON MANUFACTURING COMPANY, Orange, N. J., announces that it has acquired the business of the Battery Supplies Company, of Newark, N. J., manufacturer of the Gladstone-Lalande battery and the BSCO battery, together with all patents, rights, etc., appertaining to the manufacture of these batteries. The name of the Battery Supplies Company has been discontinued and that company merged with the Edison Manufacturing Company. As the Gladstone battery elements were designed to be interchangeable with the Edison types, the Gladstone-Lalande battery will be retired, and sales or renewals of the Gladstone-Lalande battery will hereafter be ordered by the Edison types. The Edison Manufacturing Company will continue to make the BSCO 350-ampere-hour cell for railroad work, and, in addition, the same type of cell with special low-temperature electrolyte for the same class of work at points where low temperatures affect the ordinary sodium-hydrate electrolyte. This battery will also be manufactured in the 200-ampere-hour size, in two different styles, one with a liquid-tight, steel-enameled jar for portable engines and marine engines used on fresh water; the other with a liquid-tight porcelain jar for use on launches running in salt water and on stationary engines.

Directory of Electrical and Allied Engineering and Scientific Societies.

(Published in the Second Issue of Each Month.)

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. Secretary, L. O. Howard, Cosmos Club, Washington, D. C.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, Dr. J. W. Richards, Bethlehem, Pa. Fall meeting, New York city, October 30-31.

AMERICAN ELECTROTHERAPEUTIC ASSOCIATION. Secretary, Dr. Albert C. Geyser, 352 Willis avenue, New York city.

AMERICAN FOUNDRYMEN'S ASSOCIATION. Secretary, Dr. Richard Moldenke, Watchung, N. J.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, Engineering Societies Building, 29 West Thirty-ninth street, New York city.

AMERICAN MATHEMATICAL SOCIETY. Secretary, F. N. Cole, 50 West 116th street, New York city.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION. Secretary, J. W. Taylor, Old Colony Building, Chicago, Ill.

AMERICAN ROENTGEN RAY SOCIETY. Secretary, Dr. G. C. Johnson, 514 Bijou Building, Pittsburg, Pa.

AMERICAN SOCIETY FOR TESTING MATERIALS. Secretary, Professor Edgar Marburg, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF CIVIL ENGINEERS. Secretary, Charles Warren Hunt, 220 West Fifty-seventh street, New York city.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Secretary, Calvin W. Rice, 29 West Thirty-ninth street, New York city.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS. Secretary, A. P. Folwell, 239 West Thirty-ninth street, New York city. Annual meeting, Atlantic City, N. J., October 20-23.

AMERICAN STREET AND INTERURBAN RAILWAY ASSOCIATION. Secretary, B. V. Swenson, Engineering Societies Building, 29 West Thirty-ninth street, New York city. Annual convention, Atlantic City, N. J., October 12-16.

AMERICAN STREET AND INTERURBAN RAILWAY ACCOUNTANTS' ASSOCIATION. Secretary, Elmer M. White, treasurer Birmingham Railway, Light and Power Company, Birmingham, Ala. Annual convention, Atlantic City, N. J., October 12-16.

AMERICAN STREET AND INTERURBAN RAILWAY CLAIM AGENTS' ASSOCIATION. Secretary, B. B. Davis, claim agent Columbus Railway and Light Company, Columbus, Ohio. Annual convention, Atlantic City, N. J., October 12-16.

AMERICAN STREET AND INTERURBAN RAILWAY ENGINEERING ASSOCIATION. Secretary, J. W. Corning, electrical engineer Boston Elevated Railway Company, Boston, Mass. Annual convention, Atlantic City, N. J., October 12-16.

AMERICAN STREET AND INTERURBAN RAILWAY MANUFACTURERS' ASSOCIATION. Secretary, George B. Keegan, 2321 Park Row Building, New York city. Annual convention, Atlantic City, N. J., October 12-16.

ARKANSAS ASSOCIATION OF PUBLIC UTILITIES OPERATORS. Secretary, J. E. Cowles, superintendent of lighting Hot Springs Light and Railway Company, Hot Springs, Ark. First annual convention, Little Rock, Ark., September 17-18.

ARKANSAS INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Charles F. Speed, Texarkana, Ark.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, W. W. Freeman, vice-president and general manager Edison Electric Illuminating Company, Brooklyn, N. Y. Annual meeting, Lenox, Mass., September 15-17.

ASSOCIATION OF ELECTRIC LIGHTING ENGINEERS OF NEW ENGLAND. Secretary, Welles E. Holmes, 308 Washington street, Newton, Mass.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P. W. Drew, Wisconsin Central Railway, Milwaukee, Wis.

CALIFORNIA ELECTRIC RAILWAY ASSOCIATION. Secretary, L. E. W. Pioda, Oak and Broderick streets, San Francisco, Cal.

CALIFORNIA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, P. T. Whittier, Spencer, Cal.

CANADIAN ELECTRICAL ASSOCIATION. Secretary, T. S. Young, Toronto, Canada.

CANADIAN STREET RAILWAY ASSOCIATION. Secretary, Acton Burrows, 33 Melinda street, Toronto, Ontario.

CENTRAL ELECTRIC RAILWAY ASSOCIATION. Secretary, W. F. Milholland, secretary and treasurer Indianapolis Traction and Terminal Company, Indianapolis, Ind.

COLORADO ELECTRIC LIGHT, POWER AND RAILWAY ASSOCIATION. Secretary, J. F. Dostal, Denver, Col. Annual convention, Glenwood Springs, Col., September 16-18.

CONNECTICUT STATE STREET RAILWAY ASSOCIATION. Secretary, F. W. Poole, Bridgeport, Ct.

ELECTRIC CLUB OF CLEVELAND. Secretary, George L. Crosby, 1200 Schofield Building, Cleveland, Ohio.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, John P. Faure, 77 Water street, Ossining, N. Y.

ELECTRICAL CONTRACTORS' ASSOCIATION OF STATE OF MISSOURI. Secretary, Charles J. Sutter, 1220 Pine street, St. Louis, Mo.

ELECTRICAL TRADES ASSOCIATION OF CHICAGO. Secretary, Frederic P. Vose, Marquette Building, Chicago.

ELECTRICAL TRADES ASSOCIATION OF PHILADELPHIA, Secretary, E. A. Symmes, 810 Drexel Building, Philadelphia, Pa. Meetings, second and fourth Thursdays of each month.

ELECTRICAL TRADES ASSOCIATION OF CANADA, LIMITED. Secretary, William R. Stanley, Royal Insurance Building, Montreal, Canada.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliott, Claus Spreckels Building, San Francisco, Cal. Monthly meetings, San Francisco, first Thursday of each month.

ELECTRICAL TRADES SOCIETY OF NEW YORK (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall street, New York city. Board of directors meets second Friday of each month.

EMPIRE STATE GAS AND ELECTRIC ASSOCIATION. Secretary, Charles H. B. Chapin, 154 Nassau street, New York city.

ENGINEERS' CLUB OF PHILADELPHIA. Secretary, H. G. Perring, 1317 Spruce street, Philadelphia, Pa.

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES. Secretary, J. I. Lyle, 39 Cortlandt street, New York city.

ILLINOIS INDEPENDENT TELEPHONE ASSOCIATION. Secretary, C. A. Camp, Henry, Ill.

ILLINOIS STATE ELECTRICAL ASSOCIATION. Secretary, H. E. Chubbuck, La Salle, Ill.

ILLUMINATING ENGINEERING SOCIETY. Secretary, Van Rensselaer Lansingh, Engineering Societies Building, 33 West Thirty-ninth street, New York city. Annual convention, Philadelphia, Pa., October 5-6.

INDEPENDENT TELEPHONE ASSOCIATION OF TEXAS AND LOUISIANA. Secretary, C. A. Shock, Sherman, Tex.

INDIANA ELECTRIC RAILWAY ASSOCIATION. Secretary, P. H. White, Indianapolis, Ind. Monthly meetings, second Tuesday of each month.

INDIANA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, C. S. Norton, Indianapolis, Ind.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y.

INTERNATIONAL INDEPENDENT TELEPHONE ASSOCIATION. Secretary, J. B. Ward, Grand Rapids, Mich. Secretary's office, Monadnock Building, Chicago, Ill.

IOWA ELECTRICAL ASSOCIATION. Secretary, W. N. Keiser, Des Moines, Iowa.

IOWA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, C. C. Deering, Boone, Iowa.

IOWA STREET AND INTERURBAN RAILWAY ASSOCIATION. Secretary, L. D. Mathes, Dubuque, Iowa.

KANSAS GAS, WATER, ELECTRIC LIGHT AND STREET RAILWAY ASSOCIATION. Secretary, James D. Nicholson, Newton, Kan. Annual meeting, Pittsburg, Kan., October 8-10.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION. Secretary, W. G. Turpine, Henderson, Ky.

MAINE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, M. E. Crow, Houlton, Me.

MAINE STREET RAILWAY ASSOCIATION. Secretary, E. A. Newman, 471 Congress street, Portland, Me.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby street, Boston, Mass. Meets second Wednesday of each month, except July and August.

MASTER CAR BUILDERS' ASSOCIATION. Secretary, J. W. Taylor, 390 Old Colony Building, Chicago, Ill.

MICHIGAN ELECTRIC ASSOCIATION. Secretary, A. C. Marshal, Port Huron, Mich.

MICHIGAN INDEPENDENT TELEPHONE ASSOCIATION. Secretary, A. A. Burch, Battle Creek, Mich.

MISSOURI ELECTRIC LIGHT, GAS AND STREET RAILWAY ASSOCIATION. Secretary, Claude L. Clary, Sikeston Electric Light and Power Company, Sikeston, Mo.

MISSOURI INDEPENDENT TELEPHONE ASSOCIATION. Secretary, George W. Schweer, Windsor, Mo.

NATIONAL ARM, PIN AND BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 94 Genesee street, Utica, N. Y.

NATIONAL ELECTRICAL TRADES ASSOCIATION. Secretary, Frederic P. Vose, 1343 Marquette Building, Chicago.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, John F. Gilchrist, Commonwealth Edison Company, Chicago, Ill.

NEBRASKA ELECTRICAL ASSOCIATION. Secretary, William Bradford, Lincoln.

NEBRASKA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. E. Mattison, Lincoln, Neb.

NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 60 State street, Boston, Mass.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl street, Boston, Mass. Meetings held on fourth Thursday of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, Engineering Societies Building, 29 West Thirty-ninth street, New York city.

NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. Max Eaton, Niagara Falls, N. Y.

NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary, R. N. Kimball, Kenosha, Wis.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio.

OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, O. O. Welsheimer, Columbus, Ohio.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, F. W. Ballard, Cleveland, Ohio.

OHIO STREET RAILWAY ASSOCIATION. Secretary, Charles Currie, Akron, Ohio.

OKLAHOMA ELECTRIC LIGHT, RAILWAY AND GAS ASSOCIATION. Secretary, Galen Crow, Guthrie, Okla.

OLD TIME TELEGRAPHERS' AND HISTORICAL ASSOCIATION. Secretary, John Brant, 195 Broadway, New York city.

ORDER OF THE REJUVENATED SONS OF JOVE. C. B. Roulet, Mercury, Dallas, Tex. Annual meeting, Buffalo, N. Y., October 15-16.

PACIFIC COAST ELECTRIC TRANSMISSION ASSOCIATION. Secretary, Samuel G. Reed, Portland, Ore.

PENNSYLVANIA ELECTRIC ASSOCIATION. Secretary, E. S. Smith, Towanda.

PENNSYLVANIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, H. E. Bradley, 135 South Second street, Philadelphia.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION. Secretary, Charles H. Smith, Lebanon, Pa.

PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Col. Meetings, second Saturday of each month.

RAILWAY SIGNAL ASSOCIATION. Secretary, C. C. Rosenberg, Bethlehem, Pa. Annual meeting, Washington, D. C., October 13-15.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, Arthur L. Williston, Pratt Institute, Brooklyn, N. Y.

SOUTH DAKOTA INDEPENDENT TELEPHONE ASSOCIATION. Secretary-treasurer, E. R. Buck, Hudson, S. D.

SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION. Secretary, J. A. Myler.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, J. H. Pardee, J. G. White & Company, New York, N. Y.

TEXAS INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Charles F. Speed, Texarkana, Ark.

UNDERWRITERS' NATIONAL ELECTRIC ASSOCIATION. Secretary Electrical Committee, C. M. Goddard, 55 Kilby street, Boston, Mass.

VERMONT AND NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION. Secretary-treasurer, G. W. Buzzell, St. Johnsbury, Vt.

VERMONT ELECTRICAL ASSOCIATION. Secretary, C. C. Wells, Middlebury Electric Light Company, Middlebury, Vt.

VIRGINIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, B. L. Fisher, Rocky Mount, Va.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 382 Ohio street, Chicago, Ill.

WESTERN SOCIETY OF ENGINEERS (Electrical Section). Secretary, J. H. Warder, 1737 Monadnock Block, Chicago, Ill.

WISCONSIN ELECTRIC AND INTERURBAN RAILWAY ASSOCIATION. Secretary, Clement C. Smith, president Columbia Construction Company, Milwaukee, Wis.

WISCONSIN INDEPENDENT TELEPHONE ASSOCIATION. Secretary, J. C. Crowley, Jr., Superior, Wis.

DATES AHEAD.

Association of Edison Illuminating Companies. Annual meeting, Lenox, Mass., September 15-17.

Colorado Electric Light, Power and Railway Association, Glenwood Springs, Col., September 16-18.

Old Time Telegraphers' and Historical Association, and Reunion of Military Telegraphers, Niagara Falls, N. Y., September 16-18.

Arkansas Association of Public Utilities Operators. First annual convention, Little Rock, Ark., September 17-18.

Illuminating Engineering Society. Annual convention, Philadelphia, Pa., October 5-6.

Empire State Gas and Electric Association. Annual meeting, New York city, October 7.

Kansas Gas, Water, Electric Light and Street Railway Association. Annual meeting, Pittsburg, Kan., October 8-9.

American Street and Interurban Railway Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Accountants' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Claim Agents' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Engineering Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Manufacturers' Association. Annual convention, Atlantic City, N. J., October 12-16.

Railway Signal Association. Next meeting, Chicago, Ill., September 8. Annual meeting, Washington, D. C., October 13-15.

Order of the Rejuvenated Sons of Jove. Annual meeting, Buffalo, N. Y., October 15-16.

American Society of Municipal Improvements. Annual meeting, Atlantic City, N. J., October 20-23.

American Electrochemical Society. Fall meeting, New York city, October 30-31.

Record of Electrical Patents.

Week of August 25.

897,273. TROLLEY CATCHER. Michael G. Delaney, Detroit, Mich., assignor to William Degenhart, Buffalo, N. Y. An electromagnet in circuit with the trolley pole actuates the detent controlling the ratchet.

897,278. WIRELESS TELEGRAPHY. Reginald A. Fessenden, Washington, D. C. A receiver is placed in the secondary of an inductive coupling.

897,279. MEANS FOR GENERATING HIGH-FREQUENCY ELECTRIC OSCILLATIONS. Reginald A. Fessenden, Washington, D. C. One of the terminals is made of very thin sheet metal.

897,280. AUTOMATIC STOKING-INDICATOR MECHANISM. Robert Forsyth and William W. Hanscom, San Francisco, Cal. A motor-driven worm mechanism with a complementary audible and visual signal system.

897,291. METHOD OF RENDERING ELECTROLYTIC COPPER HOMOGENEOUS. Marcel A. Jullien and Emile L. Dessolle, Levallois-Perret, France. The metal is electrolytically deposited on a rotatory cylinder.

897,300. ELECTRIC CABLE CLAMP. Ernest W. Muller, Brooklyn, N. Y., assignor to Hubert Krantz, Brooklyn, N. Y. The conducting core is clamped between opposing wedge-shaped insulators.

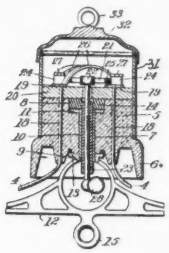
897,304. CONTINUOUS TRACK LIGHT AND AUTOMATIC SIGNAL. John M. Pitney, Jr., Lorain, Ohio. The headlight and a sound signal are operated simultaneously upon the movement of the car.

897,312. ELECRIC LOCOMOTIVE. Elmer A. Sperry, Brooklyn, N. Y. Each axle is equipped with a motor, and means are provided for rotatively coupling the axles.

897,318. OZONIZER. Jan Steynis, New York, N. Y., and Henri Chaumat, Paris, France. One set of electrodes is stationary and the other movable.

897,326. ELECTRIC HEAT UNIT OR DEVICE. George H. Wade, Atlanta, Ga. Two ribbons of insulating and heat-resisting material are connected by a wire having a high temperature coefficient.

897,350. ELECTRIC STOP MOTION FOR MOTORS AND SIGNAL FOR THE SAME. Adam Cochrane, Lowell, Mass. The circuit is controlled through the medium of a centrifugal governor.



897,457.—HANGER FOR ELECTRIC LAMPS.

897,355. ELECTRIC BLOCK-SIGNALING SYSTEM. John W. Davis, Los Angeles, Cal., assignor to Mills-Piddington Cab Signal Company, Los Angeles, Cal. The insulated sections of the rails are provided with magnets effecting the electric connections.

897,394. ELECTROMAGNETIC LOCKING DEVICE. Charles O. Peters, Winthrop, Mass. The core of the electromagnet serves as a detent, and the latch serves as an armature.

897,401. ELECTRIC SIGNALING SYSTEM. Harry C. Reagan, Butler, Pa., assignor of one-half to John H. Barrett, Mars, Pa. A safety stop bar is operated through a single wire for drawing the current-collecting device on the car away from the trolley wire.

897,402. TROLLEY FINDER. Joseph P. Reed, Muncie, Ind. The trolley harp is provided with lateral spring members for taking up rebound.

897,410. CARBON HOLDER. Oscar A. Ross, Chicago, Ill. The electrode is held in a resilient socket member.

897,413. SIGNALING CIRCUIT. Harry O. Rugh, Sandwich, Ill. A pole-changing device acts with a polarized relay to make normal or alternate contacts.

897,454. TELEGRAPHIC TRANSMITTER. George A. Cardwell, New York, N. Y., assignor to Telegraph Transmitting Instrument Company, New York. A keyboard and key levers effect various combinations in the line circuit.

897,455. CLUSTER FIXTURE FOR ELECTRIC LIGHTS. John H. Caldwell, Philadelphia, Pa. A wireless cluster.

897,457. HANGER FOR ELECTRIC LAMPS. George Cutter, South Bend, Ind. A weatherproof insulator and cutout.

897,472. JAR FOR STORAGE BATTERIES. Joseph Marx, Buffalo, N. Y. The inner cell is fitted with an annular rim fitting over the ledge of the outer shell.

897,474. INDICATING FUSE PLUG AND HOLDER. Claude E. Mentzer, Denver, Col., assignor of one-third to Leon A. Freeman and one-third to George L. Bettcher, Denver, Col. An indicating device is released by the burning of the fuse.

897,475. ALTERNATING-CURRENT MOTOR. Maurice Milch, Schenectady, N. Y., assignor to General Electric Company. The primary member is provided with a winding distributed over a portion only of the said member. The secondary member is provided with a short-circuiting winding connected to the segments of a commutator.

897,484. PNEUMATIC CONTROL SYSTEM. Philipp Pforr, Berlin, Germany, assignor to General Electric Company. A contact device for equalizing pressures in the reservoir of an air-brake system.

897,492. ELECTRIC SWITCH. Oran O. Rider, Schenectady, N. Y., assignor to General Electric Company. A double-throw switch having its open position between its two closed positions.

897,497. STARTING AND SPEED-REGULATING RHEOSTAT. Frank J. Seabolt, Schenectady, N. Y., assignor to General Electric Company. A regulating rheostat with a double series of contacts and an electromagnetic device for closing the motor circuit through one of said resistances.

897,501. SYSTEM OF ELECTRICAL DISTRIBUTION. Matthew O. Troy, Schenectady, N. Y., assignor to General Electric Company. A phase-changing rectifier system.

897,507. SYNCHRONOUS MOTOR. Ernst F. W. Alexanderson, Schenectady, N. Y., assignor to General Electric Company. The field is provided with phase-splitting means.

897,508. ALTERNATING-CURRENT MOTOR. Ernst F. W. Alexanderson, Schenectady, N. Y., assignor to General Electric Company. The laminated primary member carries two windings of different pole numbers.

897,514. LATCH MECHANISM. Paul Behr, Berlin, Germany, assignor to General Electric Company. An automatic circuit-breaker tripping mechanism.

897,524. BLOCK-SIGNAL SYSTEM. Fred B. Corey, Schenectady, N. Y., assignor to General Electric Company. The signal-controlling relay has one winding connected to the track rails and a plurality of windings supplied with current from a plurality of different circuits.

897,525. ELECTRIC SWITCH. Frank C. De Reamer, Schenectady, N. Y., assignor to General Electric Company. A double-pole fused switch.

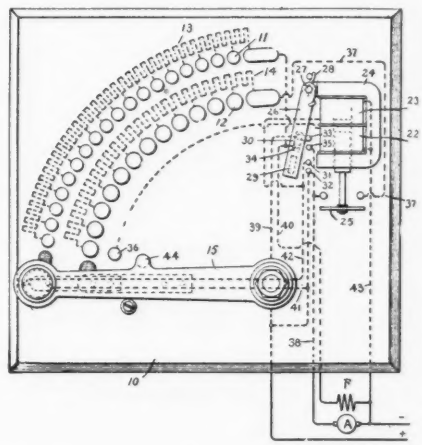
897,531. BLOCK-SIGNAL SYSTEM. Laurence A. Hawkins, Schenectady, N. Y., assignor to General Electric Company. An alternating-current relay control block-signal system.

897,536. MERCURY METER. Frank Holden, London, England, assignor to General Electric Company. The index is moved in the tube by a flow of mercury therein.

897,537. ELECTRIC CONTROLLING SYSTEM. John D. Ihlder, New York, N. Y., assignor to Otis Elevator Company, Jersey City, N. J. The electrodynamic brake circuit automatically controls the resistance in accelerating the motor.

897,538. SYSTEM OF MOTOR CONTROL. Leopold Janisch and Wilhelm Naumann, Berlin, Germany, assignors to General Electric Company. Means are provided for connecting the resistance in parallel with the armature when the controller is moved toward its off position.

897,544. RECTIFIER SYSTEM. Osias O. Kruh, Schenectady, N. Y., assignor to General Electric Company. Mercury rectifiers in series are interpolated in the several phases of the system.



897,497.—STARTING AND SPEED-REGULATING RHEOSTAT.

897,545. SINGLE-PHASE COMMUTATOR-MOTOR. Marius C. A. Latour, Paris, France, assignor to General Electric Company. The main field coils are adapted to produce a relative phase displacement of currents.

897,548. ARC-LIGHT ELECTRODE AND METHOD OF MAKING THE SAME. Charles F. Lindsay, Schenectady, N. Y., assignor to General Electric Company. A mixture containing iron oxide and titanium oxide is partly reduced and thereafter subjected in the finished electrode to a reducing action.

897,564. PANEL BOX. Frank S. Wahl, Olean, N. Y. A stamped sectional panel box.

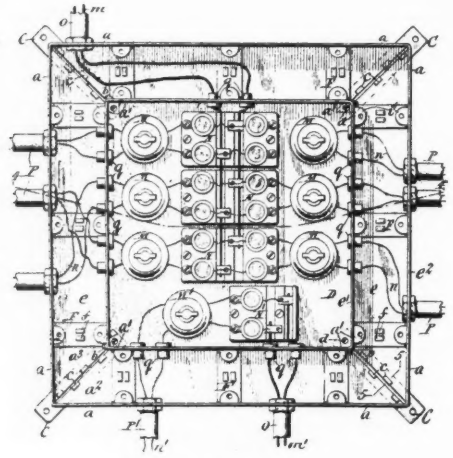
897,569. MEANS FOR PRODUCING ARTIFICIAL LIGHT FOR PHOTOGRAPHERS' USE. Frank E. Barentzen, Malden, Mass., assignor to William G. Burns, Boston, Mass. A closed compartment is separated from the main room by a partition of translucent light-diffusing material.

897,585. ELECTRIC TIME SWITCH. Jules Cauderay, Lausanne, Switzerland. A motor imparts intermittent, partial revolutions to the clock shaft.

897,590. SUBSTATION PROTECTOR. Frank B. Cook, Chicago, Ill. Carbon lightning arresters are connected in series with the fuse members.

897,602. CONTROLLER REGULATOR. Frederick M. Du Bois, Syracuse, N. Y., assignor, by mesne assignments, to American Automotoneer Company, Philadelphia, Pa. An interlocking ratchet movement.

897,603. BUFFING AND GRINDING APPARATUS. Frederick B. Duncan, Madison, Wis., assignor to Northern Electrical Manufacturing Company, Madison, Wis. A self-contained motor-driven buffing and grinding machine.



897,564.—PANEL BOX.

897,607. AUTOMATIC CALLING-ON SIGNAL. William H. Elliott, New York, N. Y. The signals are capable of being actuated when the section is occupied.

897,614. CLUSTER-LAMP SOCKET. Charles D. Gervin, New York, N. Y., assignor to the Dale Company. A wireless cluster.

897,633. ELECTROLYTIC CELL. Gilbert C. Landis, York, Pa. A tubular metal-carbon cell.

897,657. ELECTRIC AND PNEUMATIC GOVERNOR. William K. Rankin, Philadelphia, Pa., assignor to John E. Reyburn, Philadelphia, Pa. The action of the diaphragm governs the electrical circuit.

897,662. TELEGRAPHIC SELECTIVE SYSTEM. Alfred M. Roberts, Buffalo, N. Y. The selecting magnet responds to the direction of current flow.

897,667. TROLLEY WHEEL. Edward P. Sharp, Buffalo, N. Y. An integrally connecting hub is fitted with rigid outside flanged members.

897,669. INSULATOR. Frank J. Siegwart, Pittsburg, Pa. Means are provided for carrying the connector in an insulating groove.

897,670. ELECTRICAL IMPULSE RECORDER. Augustus K. Sloan, Jr., Brooklyn, N. Y. The moving member of the solenoid is provided with a stylus.

897,674. TERMINAL FOR ELECTRIC FITTINGS. Frederick A. Swan, Cliftondale, Mass. Means are provided for taking the strain off the conductor.

897,681. TELEPHONE SWITCH. Clarence Truitt, Moscow, Ida. Means are provided for signaling another station without calling the telephone exchange.

897,683. CONDUIT CAP FOR ELECTRIC INSTALLATION. Wheeler H. Vibber, New London, Ct., assignor to the Gillette-Vibber Company, New London, Ct. An insulating pipe cap.

897,692. ELECTRIC ORGAN ACTION. William R. Whitehorne, Brooklyn, N. Y., assignor to Whitehorne Organ Action Company, Jersey City, N. J. Each key is provided with a switch, stop mechanism and valve-controlling magnet winding.

897,702. ELECTRIC SIGNAL SYSTEM. Anthony A. Barbera, Philadelphia, Pa. The operation of the semaphore arm actuates an alarm member mounted in the tower house.

897,711. TIME SWITCH FOR ELECTRIC CIRCUITS. Hayden W. Brown, Waterbury, Ct. Means are provided for adjusting the switch mechanism in a predetermined position.

897,713. MOTOR STARTER. Anthony J. Burns, Oswego, N. Y. Means are provided to hold the contact member at open circuit position.

897,716. TRANSMITTER. Jesse T. Curtis, Bement, Ill. The transmitter is equipped with two diaphragms, one diaphragm having adherent to its sunken portion a carbon cup.

897,718. TELEPHONE INSTRUMENT. Wilford R. Daniels, New York, N. Y. An exterior piece for mounting over the ear piece of an ordinary receiver.

897,723. TELEPHONE SYSTEM. William W. Dean, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. The line signal is controlled by a relay.

897,731. SIGNALING DEVICE FOR TELEPHONE EXCHANGES. Thomas W. Gardner, Nashvile, Tenn. Two balanced windings have a common core, and there is a condenser in series with the operator's head-piece receiver.

897,752. OSCILLATING DESK FAN. Evrah C. Lipps, Warren, Ohio, assignor to the Peerless Electric Company, Warren, Ohio. The fan body is oscillated by means of a deflecting vane.

897,758. PROCESS FOR MANUFACTURING INDURATED FIBRE. Israel W. Marshall, Yorklyn, Del., assignor of one-half to Thomas E. Marshall, Yorklyn, Del. A plurality of vegetable paper sheets are subjected to a chemical process whereby they are partially gelatinized.

897,765. MULTIPLE TELEGRAPHONE SYSTEM. George Morin, Habana, Cuba. A plurality of revoluble members are adapted to hold magnetic impressions analogous to sound waves.

897,766. ELECTRIC CIGAR LIGHTER. Ernest P. Muller, Brooklyn, N. Y. Spring contact points are arranged to make contact with an igniting member.

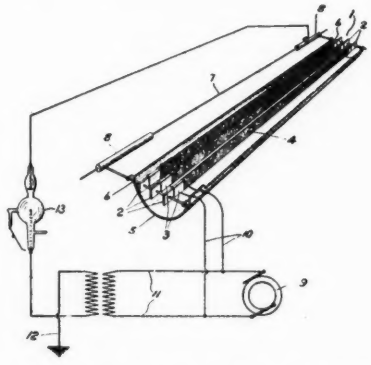
897,779. RECEIVER FOR WIRELESS SIGNALING. Valdemar Poulsen, Copenhagen, Denmark. The signal is impelled by periodically unbalancing or destroying the condition of resonance in the oscillation circuit.

897,800. LIGHTNING ARRESTER. Charles P. Steinmetz, Schenectady, N. Y., assignor to General Electric Company. A combination of spark-gap terminals and a resistance formed of an oxide, the resistance of which decreases when heated.

897,805. INCANDESCENT LAMP SOCKET. William F. Wegner, New York, N. Y., assignor to Stephen T. Williams, New York, N. Y. The socket is adapted to retain the lamp by a direct thrust.

897,812. INVERSE TIME-LIMIT RELAY. Peter Bendmann, Berlin, Germany, assignor to General Electric Company. The armature is operated in a strong magnetic field.

897,823. MARINE SIGNALING LAMP AND THE LIKE. Henry Endall, Southampton, England. A water-tight casing contains an illuminating means.



897,831.—MEANS FOR PREVENTING OFFSET IN CONNECTION WITH PRINTING.

897,824. POLE SHOE. William R. Everett and Edwin J. Newton, Chicago, Ill. The pole shoes are equipped with extended arms, these arms being offset on opposite sides.

897,831. MEANS FOR PREVENTING OFFSET IN CONNECTION WITH PRINTING. John Hergesheimer, Philadelphia, Pa., assignor to the Curtis Publishing Company, Philadelphia, Pa. Means are provided for effecting a discharge of the static electricity in the moving sheets.

897,852. SAFETY FUSE. Joseph Sachs, Hartford, Ct., assignor to the Sachs Company, Hartford, Ct. The fuse is comprised of a plurality of separately insulated and sheathed conductors connected in multiple to common electrodes.

897,858. AUTOMATIC CIRCUIT-BREAKER. Henry P. Ball, New York, N. Y., assignor to General Incandescent Arc Light Company, of New York. A double- throw switch which is spring-actuated to its open position.